

# CHEMICAL & METALLURGICAL ENGINEERING

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# CHEMICAL & METALLURGICAL ENGINEERING

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## Chemists' Club

### Employment Bureau

FOR many years the Chemists' Club of New York has maintained an employment bureau for the benefit of chemists. The small service fee charged has made it possible for the bureau to show a profit in good times, but in bad times, when it really can be of the greatest benefit, it becomes a liability. At the last meeting of the American Chemical Society it was proposed to turn the bureau over to it, but the Council rejected the proposal. In our judgment this was a mistake, because the large membership of the Society would give greater scope to the work of the bureau. Further, this business of fitting men to the places where they belong is a function that the Society might well assume in the interest of stabilizing chemical employment. Its fears that the Society might become involved in responsibility for recommendations are quite groundless, and other objections were without much force. Nevertheless the Society rejected the offer, and the bureau is to remain with the Chemists' Club. It will continue under the direction of Dr. MOODY, who has succeeded the late Prof. BASKERVILLE as director of the department of chemistry of the College of the City of New York. Under his past direction the bureau has rendered splendid service for a number of years, and we commend it to our readers.

## The Beginnings Of Science

UNFORTUNATELY to many students who are at once intelligent and diligent the beginnings of both chemistry and physics are difficult and dull. Many who have "had" or "done" these studies remember them as so many hours of misery which are recalled with no enlightenment whatever. They studied to pass examinations and then the subjects were dismissed.

How then are we to get the scientific vision spread abroad among the intelligent part of the community? What seems needed rather than so many hours of chemistry or physics or biology as "a science" which leads to the passing requirement at school or college is a more general and correlated course in science as a whole. Dr. OTIS W. CALDWELL, director of the Lincoln School of Teachers College, Columbia University, with Prof. W. L. EIKENBERRY of the University of Kansas, wrote a textbook several years ago on the subject that points out the road. The sciences are called on for explanation indiscriminately as needed under the project method of teaching. Various efforts by other authors along similar lines have appeared since then. There is now in process of publication by Putnam's a beautiful exposition in four volumes called "The Outline of Science" by Prof. J. ARTHUR THOMSON of Aberdeen. Later and cheaper editions may bring it also into schools. It

begins with the most engaging introduction to astronomy we have ever read and then proceeds along lines of biology, geology and physical chemistry in the first and only volume so far published.

Of course, in secondary schools we have the difficulty of preparing for college entrance examinations, but these difficulties are bound to be solved some day. Our contention is that the better way to begin science is as one great co-ordinated empire of knowledge. We have specialized too much at the beginning, and this does not lead to wisdom or even to scholarship. Everyone needs this larger vision to illuminate life. We men of science need it so that we may sense co-ordination and perceive the truth. Let's teach the high lights of nature to all, and then those who specialize in their work will be more enlightened than we of this generation.

## Chemistry as the Foundation for Medicine

IT WAS along in about 1896, in conversation with the late Dean HENRY BOWDITCH of the Harvard Medical School, that we inquired where his best students came from. "Harvard College, perhaps?" we asked, as though, in such a Brahmin atmosphere as Bowditch Hill in Jamaica Plain, no other thought was possible. "Not at all," replied the old master of physiology. "Harvard is like any other college; some students are well prepared, and some are not. There is one place and one only in the United States from which they come inspired by a great teacher, and that is the Sheffield Scientific School of Yale. Their contact with Professor CHITTENDEN there is wholly unique. He gives them a remarkable course in physiological chemistry and he makes them understand. It is a great pity that there are not more like him. His students get the scientific attitude of mind. They come here with the chemical curiosity; with the will to search where the treasure is hid. Indeed, I may say we have as students graduates from the Sheffield Scientific School who have studied with CHITTENDEN, and then we have others. It is hard to make a comparison between them." That was about 1896. By 1898 the Corporation of Yale, having had difficulty in finding a good director for Sheffield, took Dr. CHITTENDEN from his illuminating work as professor, promoted him out of the sphere of it and into the adjudication of such serious problems as what to do with a student who is laggard in his attendance at chapel, or the settling of quarrels between two boys, or determining whether X, who is deficient in English, may or may not play on the football team.

To be dean of a college is an honorable calling. So it is to be president of a bank or agent for HENRY FORD's automobiles. But these things do not compare with teaching, real teaching, which is the greatest of all

the arts. Here was the one place in America where students of medicine were getting the start they needed, and it was put out of commission, so far as they were concerned, by the "promotion" of a professor.

Dr. BAILLY of Texas says we have far too many students of chemistry at this time. Not too many for the general good, but too many to find good places. So he suggests that they be inducted into organic research, and that with this and with biological chemistry as working capital to help them to establish themselves in the study of medicine we may look for a new generation of physicians. We all know the difference between the few physicians who have chemical understanding as diagnosticians and as physicians who know what to do, and the many who have only that smattering of chemistry which is the usual equipment of the practitioner.

Had it not been for the unfortunate, short-sighted—indeed almost blind—decision of the authorities of the Yale Corporation back in 1898 when they took Dr. CHITTENDEN from his chair of physiological chemistry and put him at the desk of the dean, we should have had more of those superpractitioners of medicine today who have "the will to search where the treasure is hid."

At the regular meeting of the Corporation on March 11, very complimentary resolutions were adopted over Dr. CHITTENDEN's successful leadership of the Sheffield Scientific School for nearly a quarter of a century. And well they might resolve to this effect, for Dr. CHITTENDEN is a man of rare ability, and whatever he does he does well. But we think the Corporation should also have passed a vote of censure upon itself for its act in 1898 when, for its own convenience, it robbed the profession of medicine of so important a source of inspiration. It was an act that without doubt condemned a large number of persons to untimely death.

## Nickel in Steel vs.

### Brains in Heat-Treatment

SOME incredulous questioning was leveled at Dr. RICHARD MOLDENKE at the recent meeting of the American Electrochemical Society when he stated that a leading German steel foundry was now able to produce plain carbon steel castings the equivalent of 4 per cent nickel steel castings made before the war. The details were not forthcoming. Apparently they were in line with the steps which German metallurgical industry had been forced to take by reason of war shortages of alloys, deoxidizers and high-quality ores. Captured ordnance was often full of metal of most suspicious chemical analysis, yet apparently good enough for the stresses it had to bear. The speaker inferred that such things were possible only by minute attention to correct metallurgical practice at every stage; ordinarily correct chemical composition is an indication that such painstaking care had been taken. Yet it is the care which is essential; given that, the composition may be what it may.

To a certain degree that is true, but if the practice is right the chemical analysis will usually come out right at the same time. For instance, a steel or iron which has been desulphurized must first have been deoxidized, and the quality in the product may actually be caused by freedom from gas rather than freedom from sulphur. But nickel is supposed to give certain peculiar and unique qualities to metal which ought therefore to be lacking when nickel is absent. One might cite the

toughness and resistance to cracking which a nickel-steel armor plate exhibits when hit by a high-velocity shell if he were sure that this toughness were not due to a laminated structure caused in turn by non-metallic inclusions (dirt) rather than nickel!

Is not the wonderful German metallurgy which produced carbon steels the equivalent of nickel steel only an indication of what is going on elsewhere among up-to-date metallurgists? Perhaps they have known for some time that good nickel steel is not the easiest thing in the world to make, and have also discovered that sound, clean, simple steels can be wonderfully improved by correct heat-treatment. In other words, were they not making a mediocre nickel steel 10 years ago, while today they are making an excellent heat-treated carbon steel?

That this is at least a reasonable assumption may be inferred from the following: Hütte (1915), the reliable German engineering handbook, quotes the following physical properties for annealed 4 per cent nickel steel castings for machine parts: ultimate strength, 78,000 lb. per sq.in.; elastic limit, 50,000 lb. per sq.in.; elongation, 25 per cent; reduction in area, 55 per cent. This would probably be acceptable to them, but is far from being as good as can be obtained. Quoting from tests taken from mill production, HALL, NISSEN and TAYLOR (1919) quote many double-treated 0.26 carbon steel castings made in America which average ultimate strength 83,000 lb. per sq.in., elastic limit 51,000 lb. per sq.in., elongation 30 per cent, reduction in area 58 per cent, Fremont impact number 28, cold bend about 1 in., 180 deg.

Would you insist on nickel in the steel or brains in the heat-treatment?

## Learning

### How to Think

IN THEORY we are always ready to admit that as a race we are going to make progress along new lines in future, but in practice we rather stick to the line of developing and expanding old ideas. We are disposed to extrapolate rather than seek to strike off at a tangent.

Just lately there is rather a new idea going the rounds, that while in the last hundred years development has been along the line of subjugating material forces, the next hundred years is going to see great development in subjugating the human brain—in other words, in learning how to think.

There are those to whom this prediction will not appeal. They are jealous of our ability, or supposed ability, to think, and at once suspect that the proponents of this new notion are actuated by a belief that most of the subjugation of materials and physical forces has been accomplished. Perish the thought, they are likely to explain, that we are any more than on the threshold, that we have done more than gather up a few grains of sand on the ocean's shore!

We may perhaps get some distance toward a fair viewpoint by comparison and analogy. We can observe in some cases what men's aspirations and expectations used to be, and note whether they have been fulfilled. A convenient case is found in railroading. The history of steam railroading in the United States covers less than a century. Go back half way, and we find certain train speeds achieved, with expectation that speeds would increase almost indefinitely, but the in-



crease has not occurred. Twenty years ago an 18-hour train between New York and Chicago was established, but this was achieved by the train keeping at it rather than by its going faster than trains had gone many years earlier. The speed of the fastest trains has increased but little in the second half of railroad history to date.

It is no dreadful thing to admit that along certain lines we have succeeded, have got along far enough, and can afford to go in for wholly new things. It is only about 20 years since we began developing physical efficiency in performing manual operations, and there are not a few now who believe we have gone too far, that we have been trying to produce what really involves a greater drudgery in work. The ergograph helps to tell us when and how long the rest periods for the muscles should be, but it is certain we are not living our lives rightly if we mold them from cradle to grave with ergograph records as the sole rule of faith and practice.

Now, as a matter of plain fact, probably everyone who really thinks knows that he does not know how to think. He has very likely had moments of inspiration that have been depressing rather than elevating, through showing what a waste of time the rest of life has been without similar quick and successful thinking. Here again there will be those who will object, holding that this is merely some fresh press-agent stuff for that fool psychology. Even though most people will admit that "psychology" as it has been taught has been rather dry, here is another point at which we can use analogy and comparison. There was "political economy," invented a long while ago and justifiably dubbed "the dismal science." Lately it has developed into something interesting and very useful, sometimes called "quantitative economics," not because it has made basic discoveries or formulated new theories, but because facts have accumulated, statistical and otherwise. Psychology is in line for a similar development. It is getting away from the question of whether or how an amoeba thinks, and in the next few decades it may tell us, not how we think when we think the wrong way, but how we ought to think so that instead of there being an occasional flash of genius in a brain here and there we shall all be geniuses all the time. Then we can take things easy.

### Lowering Costs

#### Through Material Handling

IT HAS long been a recognized fact and accepted as common practice that bulky raw materials could be handled by mechanical equipment in a more economical and expeditious manner than by manual labor. We are so used to seeing coal, stone, sand, gravel, ore, sugar cane, pulpwood and similar material handled in this way that the fact has ceased to arouse much interest. We see the raw materials unloaded and stored, and pass on without thought as to how these are handled beyond the first storage point.

But what happens to them is really of great importance. Suppose we ask how many times each pound of raw material must be moved before the finished product is obtained and how much this movement costs. An illuminating example comes to mind. A plant manufacturing refractory brick had the raw materials delivered by rail from a trestle directly into bins. From that point—through every process, grinding, mixing, molding, drying, burning, storing and shipping—the material was

entirely transported by hand in wheelbarrows. One movement consisted in transporting the brick from the drying shed to the kilns. It required eight barrowmen two days to wheel sufficient brick for one charge. At a rate of \$4.50 each per ten-hour day this brought the cost of transporting the brick for a single kiln charge up to \$72, or about \$3.50 per ton.

The cost of discharging the kiln to storage was almost as great. There were five other wheelbarrow handlings for each brick besides the two mentioned above. In addition there were numerous intradepartment handlings, some of which possibly could not be eliminated; and which brought the total handling up to 28 pounds of material for each pound of product. As a result, handling operations occupied almost two-thirds of the labor of the plant and accounted for approximately one-half of the cost of the finished brick.

This, perhaps, is a particularly bad case; but many others exist which are almost as startling. Anywhere from one-third to nine-tenths of the cost of manual handling can be saved by the application of machine equipment in a plant where it is at all possible to install it; and this means with the interest charges on the investment and the depreciation charges directly charged to the handling costs. It is of course necessary to make an analysis of a plant before any handling equipment is installed, as it is a matter for careful study and skilled judgment as to just what equipment will best serve any special case. Most of the failures of material-handling installations have been due to the fact that the equipment used has not been proper for the plant where installed. The number of industries, however, in which some improvement cannot be made through the use of the proper equipment is few indeed.

There are additional benefits derived from the correct application of handling equipment, all of which have either a direct or an indirect effect in lowering costs. In many plants where the actual manual handling is less than in the example cited above, or where the process of manufacture is more complicated and more difficult to control, the enhanced efficiency following the installation of handling equipment eases the task of management and greatly lowers the incidental costs. This may be due to less space requirement for the same production, more rapid movement of goods in process, less quantity of goods in process inventory, a more easily determined and steadier output contributing to more efficient work in sales and purchasing, and the speeding up of labor in an unconscious effort to keep the pace of the machines.

The objection is often raised that handling equipment adds complication to the plant, requires an increased force of mechanics to care for it, and tends to hold up production through breakdowns. The first and second of these objections have proved in practice to be negligible, while the third, at one time true, no longer is important, as the handling equipment available is at least as reliable as the other equipment in use in most plants.

It seems that only ignorance of the actual accomplishments of handling equipment and inertia toward the acceptance of new methods have prevented a much greater application of mechanical handling. We believe that the increased production efficiency and lowered cost of production to be obtained through this equipment make it vitally important for all who manage or operate industries to study their plants with a view to obtaining to the full the advantages which may follow their use of such equipment.

## Readers' Views and Comments

### Ghosts and Undeveloped Senses

*To the Editor of Chemical & Metallurgical Engineering*

SIR:—Here's Sir Arthur Conan Doyle on a lecture tour talking about ghosts, and whenever they talk about ghosts we poor chemists are bombarded with questions. But as soon as we undertake to present the requirements for sensory phenomena, we are likely to be informed that we don't know anything about the whole subject (which is correct, so far as most of us can understand), on the ground that these spirits and the stuff they are made of are immaterial—and that worries us again, because we want to know how they can be seen and felt and heard, if they are immaterial.

Sir Oliver Lodge and Sir Arthur Conan Doyle insist on the postulate of ether for their familiar manifestations; but to most of us ether is needed only for the wave theory of light, and in current thought this postulate is less firmly insisted upon than it was 10 years ago. If we postulate ether at all, we must postulate it as so dense that matter is, in effect, holes in the ether rather than particles of any sort.

In the Orient, spirits are not such ghosts as we discuss and fear if we think we see them. In Japan, for instance, in Buddhist temples after the proper offerings have been made and the requisite prayers said, it is held that the spirit of one departed comes sailing through the air like an infinitely minute spark which penetrates any wall, and is too small to be seen or felt. We, on the other hand, want them life-size, but shadowy enough to convince us that they are really ghosts, and not solid persons.

A big, fifteen-dollar book by Baron Albert von Schrenck-Notzing, M.D., of Munich, was published in Germany in 1913, and the English translation appeared in 1920 under the title "Phenomena of Materialism" (Duttons). This brought out a tissue-like manifestation emanating from a medium known as Eva C., a French girl, which Dr. Schrenck called "teleplasm." It was a moist, film-like substance that usually, but not always, came from her mouth, and occasionally took rather vague shapes—and then seemed to go back again. It was cool and moist to the touch. Sir Arthur refers to some such ghost-stuff which he calls "ectoplasm," which is probably the same sort of emanation. It seems more like some kind of a ruminant emanation than an honest-to-goodness ghost to one who is not gifted with the faculty of ready belief.

What the spiritualists seem to have missed by clinging fast to the ether theory is what may happen without it. We cultivate but two of our four major senses: sight and hearing. Smell we neglect utterly, and touch we know nothing about. Our eyes perceive light waves from  $\frac{1}{60,000}$  to  $\frac{1}{37,000}$  of an inch in length. Longer or shorter we do not see. Our ears hear atmospheric waves from one inch to a hundred feet in length, and we have no organs of apprehension beyond these limits. Therefore the most amazing and exciting phenomena may take place within a room, may frighten insects, but leave no impression on us the while we think every-

thing is at once quiet and dark. Now since we know nothing of touch and pay scarcely any attention to it so long as we can see, we have in this sense a vast field of the unknown, which is exactly the place for ghosts. For the very reason that we know so little, nobody can deny that a person who is supersensitive to touch may become cognizant of all sorts of shapes and sounds and goings on to which the rest of us are blind and deaf and numb. Why insist that we can see that which is not matter when all these goings on are possible? It is a splendid chance, and we are amazed that the mediums have not adopted it. MARTIN SEYT.

### Hardness of Solid Solutions

*To the Editor of Chemical & Metallurgical Engineering*

SIR:—It occurred to me, after hearing Dr. Jeffries' able presentation of "The Slip Interference Theory of the Hardening of Metals" before the February meeting of the Mining Engineers, following his very important paper published in your journal for June 15, 1921, that there is one point which needs to be emphasized in connection with the hardness of solid solution alloys. Suppose we take pure nickel and mix a little iron with it. Nickel happens to crystallize in the face-centered cubic structure. In going into solution, an atom of iron replaces an atom of nickel, but it does so at the expense of a certain amount of distortion in the position of the surrounding nickel atoms, and the extent to which that distortion of position may penetrate into the surrounding nickel is something concerning which we know nothing at present. Ordinarily, the same conditions of force exist throughout the entire crystal of pure nickel. If an iron atom be introduced at any one point, either that iron atom attracts the nickel atoms with a little bit more force than nickel atoms attract each other, or it attracts them with a little bit less force; or, in the extremely rare case (I scarcely can conceive of it as actually occurring), it exerts identically the same force. That last alternative may be put out of mind. In the other cases, the field of influence, the knot, the key, or whatever it may be called, that corresponds to the iron atom is a good deal larger in extent than the diameter of the atom itself. It conceivably might extend for four, five, six, ten or more atom diameters before displacement of the nickel atoms from their normal position would be so slight as to be entirely negligible. ANCEL ST. JOHN.

Union Carbide & Carbon Research Laboratories,  
Long Island City, N. Y.

### Non-Flammable Mixtures of Solvents

*To the Editor of Chemical & Metallurgical Engineering*

SIR:—In your March 29 issue there appeared an article by Sievers and McIntyre entitled "Non-Flammable Mixtures of Organic Solvents for Vegetable Oil Extraction," which seems to me to call for some comment. The authors first proceed to discuss the determination of the limiting amount of the vapors of flammable solvents such as benzene, gasoline, etc., which can be mixed with vapors of a non-flammable solvent



such as carbon tetrachloride before a flammable mixture results. Now it is obvious that none of the so-called flammable vapors are really flammable by themselves, but only when mixed with oxygen. Furthermore, it is a theoretical as well as an experimental fact that all such vapors when mixed with air are flammable only within quite narrow limits of concentration. For instance, at ordinary temperatures and pressures, the limits for benzene vapor are about 1.5 per cent and 6 per cent by volume.

The method of testing for flammability outlined in the article referred to was very indefinite, no mention being made of the amount of air admixed with the vapors. In fact, one is led to infer that the mixture through which a spark was sent consisted purely of the vapors in question. If this is so, the fact that ignition was obtained in some cases would certainly contradict all the previous theoretical and experimental evidence. If, on the other hand, the vapors were mixed with air during the test, it is apparent, from the nature of the test as outlined, that the concentration of the solvent vapors must have been indefinite and consequently the possibility of an ignition is determined not only by the relative amounts of, say, benzene and carbon tetrachloride, but also by the concentration of oxygen. In view of these facts, it does not seem that one is justified in drawing any conclusions from the tests as to the effect of non-flammable liquids on the flammability of benzene and gasoline.

Newtonville, Mass.

BARNETT F. DODGE.

### Notes on the Manufacture of High-Speed and Tungsten Steels

To the Editor of Chemical & Metallurgical Engineering

SIR:—I have read with great interest J. W. Weitzenkorn's notes in your issue of March 15, 1922, which are a remarkable confirmation of the theory that carbides in high-speed steels are not made soluble by any heat-treatment. As a matter of fact, they form a eutectic which melts at relatively low temperatures. In a research published in the *Zeitschrift für anorganische und allgemeine Chemie*, vol. 118, p. 55, I stated that the melting point of this eutectic in chromium steels lies at about 2,100 deg. F. (1,150 deg. C.) and in tungsten steels as low as about 1,940 deg. F. (1,060 deg. C.). A ternary eutectic exists in high-speed steels containing chromium and tungsten, and it is evident that the eutectic is melted after a careless high heat and squeezed out by subsequent forging. In Figs. 10, 11, 13 and 14 of Mr. Weitzenkorn's notes such a fusion

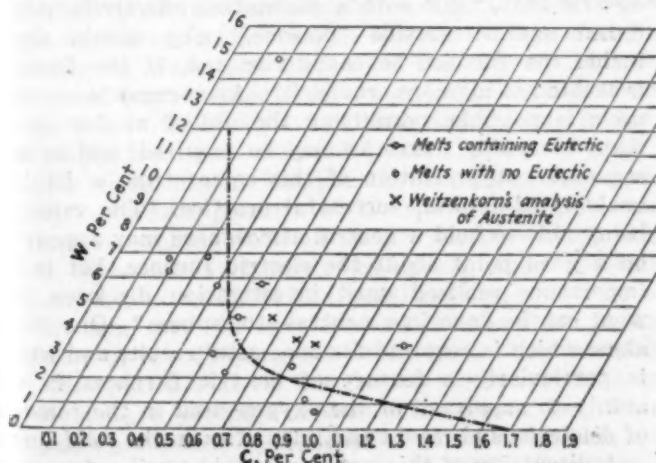


FIG. 1. SOLUBILITY LINE FOR Fe:W:C ALLOYS

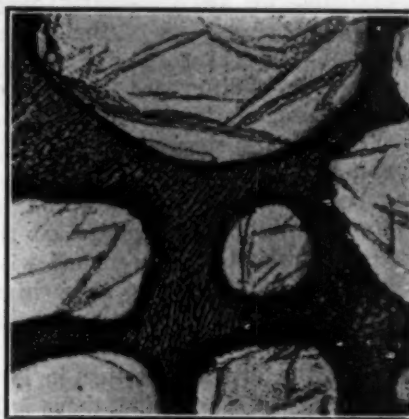


FIG. 2. CARBIDE MASS IN STEEL CONTAINING 1.90 PER CENT C AND 10 PER CENT W. ETCHED WITH HOT SODIUM PICRATE.  $\times 555$

is evident: the great freedom of the "eutectiform" carbides may be explained in this way.

Another result of my research was the approximate determination of the solubility line of carbon in chromium and tungsten steels—i.e., the line in the ternary diagram where the eutectic appears first. Fig. 1 shows that this line agrees fairly well with the results in Table II of Mr. Weitzenkorn's article. Crosses represent the chemical analysis of solutions he obtained after removing carbides from the austenite.

The structure to which the carbides revert on being heated to the melting point may be explained in another way, if we assume that the eutectic forms a series of "wires." On the left end of Weitzenkorn's Fig. 13 the "wires" are cut longitudinally and appear as narrow bands, but in the middle they are cut across; therefore the wires appear like spheroidal carbides. Massive carbides shown on the right end of Fig. 13 likewise would show this network if the sample were etched with hot sodium picrate. Fig. 2 shows such a carbide mass etched with sodium picrate in a tungsten steel containing 10 per cent W and 1.90 per cent C.

Düsseldorf, Germany.

DR. K. DAEVES.

### Electric Furnace Melting

To the Editor of Chemical & Metallurgical Engineering

SIR:—Referring to the letter of Henry Traphagen in the issue of March 22, I was glad to note that the editor added a note to correct the erroneous impression conveyed as to limitations of the process.

We have all been too prone to leave uncriticized the impressions which seem to exist regarding the phenomena attributed to electric heat, when it should be considered simply as a means to an end. As you have so well stated in your editorial, the electric furnace permits the metallurgist to make use of slags for refining purposes which would be impossible to maintain by any other method of heating.

It is unfortunate that on account of the possibility of producing steel in the electric furnace equal in every way to the quality of crucible steel, we have not only compared the two grades of steel, but also the two methods of production and have tried to show points of similarity. To my mind the electric furnace process could better be compared with open-hearth practice, which it closely resembles in many important details, but which it excels on account of its greater flexibility and more accurate control of reactions.

Like the open-hearth, we have to deal with a large

mass of metal and we are constantly observing slag conditions. The entire success of the process, in fact, with exception of temperature, is due to maintaining a proper slag. The chief difference from the open-hearth bath is the advantage attained by the possibility of working with a reducing slag.

Probably one reason for many failures of electric melting has been the generally accepted idea that a crucible melter should be selected to do the melting. Far better success would have been had with an open-hearth man, if one took pains to show him the function of a reducing slag and instructed him how to maintain it. The study of slags is an old problem to him, while with the crucible melter it is a mystery from the start. On the other hand, there is little doubt as to the advantage of having a man familiar with crucible practice to take charge of the pouring, which in itself is an exceedingly important operation.

As to the points made in the letter in regard to impossibility of making good steel from poor grades of scrap, the writer again has been influenced by crucible practice. It is possible to make an excellent grade of steel from low-grade scrap in the electric furnace, just as much so as in the open-hearth in fact; but it is usually not advisable to do so, as the additional cost of current due to the extra time required more than offsets any saving there would be in the price of the scrap.

As to the reference to porous castings made by the electric process, an examination of the melting logs will probably reveal as the outstanding feature a very rapid production of heats. It is of course very desirable to use current for as short a time as possible and to get a high rate of production, but it is considerably more important that the heat should be properly killed before tapping, and this usually requires quite a little time to get correct conditions.

This is perhaps the reason why aluminum is used so freely. But it should not be overlooked that a small amount of aluminum is a good thing to make absolutely sure that the deoxidation has been complete. It has been common practice for many years not only in open-hearth steels but in many plants producing crucible steel to introduce a few ounces for each ingot.

The steel-casting organization has many conditions to meet in order to produce sound castings. It is necessary to have not only a quiet steel, but, what is just as important, properly vented molds. The production of steel castings by an organization not thoroughly familiar with all the details of production is a most hazardous undertaking and accounts for a very fair percentage of failures in this industry.

The electric furnace is a wonderful addition to the working tools of the metallurgist and already has made possible the solution of several important problems. The future will no doubt witness a very great development directly attributable to its use.

New York City.

W. H. KEEN.

To the Editor of Chemical & Metallurgical Engineering

SIR:—Mr. Traphagen, in his letter in your issue of March 22, 1922, infers that certain faults exist in electric furnaces. He should, to the extent of his ability and belief, explain the redeeming features, provided there are any. We know the electric furnace possesses many of the latter.

Unquestionably, a "cycle of ups and downs" must be traversed by any scientific innovation before it arrives at its real field of application (and the latter is gen-

erally found to be limited). The electric melting furnace has not yet been stabilized in its operation or uses. "Wild advertising" of impossibly broad fields of application has doubtless contributed to the damage, but experience has led to the belief that this has been of small significance as compared with another underlying cause hitherto rarely mentioned.

Since the first commercial application of electric furnaces, competition among so-called furnace manufacturers, instead of leading to ultimate stability in methods, recommended applications, etc., really brought into existence "furnaces" not worthy of the name. The performances of these, most naturally, detracted from the exceptionally few that were deserving of serious consideration. Furthermore, the comparative ease with which successful operation can be obtained from a "crippled" furnace installation bears out the contention that the element most damaging to the industry is the fact that the expense for engineering on the job is usually incurred at the wrong time—namely, after the furnace was installed and operated.

Where Mr. Traphagen states that the electric furnace is a "good nurse for healthy material" only, the term "healthy" should be explained. If "healthy" is intended to exclude cheap scrap, the statement is entirely misleading. To prove this, we would call attention to the following typical costs of foundry steel in the ladle:

#### I—CONVERTER

1,000 lb. low-phosphorus pig	\$21.50
1,000 lb. low-phosphorus and sulphur heavy scrap	7.25
333 lb. coke	1.17
20 per cent melting and converter loss	5.74
Ferro-alloys	1.60
Cupola refractories	.80
Cupola power and labor	1.25
Converter refractories	1.00
Converter power and labor	1.00
Cost per ton	\$41.31

#### II—OPEN HEARTH

1,000 lb. bessemer pig	\$13.50
1,000 lb. low-phosphorus and sulphur heavy scrap	7.25
6 per cent melting loss	1.25
60 gal. oil	6.00
Labor (furnace only)	1.00
Ferro-alloys	1.40
Refractory repairs	.60
Cost per ton	\$31.00

#### III—ELECTRIC FURNACE

1,500 lb. steel turnings	\$4.88
500 lb. foundry returns	3.62
3 per cent melting loss	.27
14 lb. electrodes	1.12
Refractory repairs	.40
Labor (furnace only)	1.00
Ferro-alloys	.50
Electric power	8.25
Cost per ton	\$20.04

Costs are of course based on continuous operation.

Certainly there is no wonderful cleansing power in electric heat. But with a quarantine effectively established against outside "poisons," why cannot those inside the furnace be easily removed, if the furnace is treated as a "mere crucible"? Any temperature-time cycle is possible, permitting the use of as few or as many cleansing fluxes as may be required, and in any sequence. Appreciation of this comes from a detailed analysis of typical, successful practice. The value of being able to hold a neutral atmosphere may appear to be a good point about the electric furnace, but is its importance realized until investigation discloses just what can be done in a neutral atmosphere? One thing alone which is required for successful results and which is particularly a feature of electric furnaces is the ability to supply all of the oxygen used in the removal of deleterious elements and impurities in the solid form.

A discussion of this one item would require far more



space than the present article can be allotted. Could I suggest that better progress might result if we, rather than harshly condemn the electric furnace,

(1) "Jog up" the refractory manufacturers, to keep less than 10 years behind furnace advances.

(2) Eliminate inherently bad furnace designs from the field—regardless of patents or "right to exist."

(3) Utilize sufficient engineering on all installation.

(4) Cut out "wild advertising" to the effect that the electric furnace can do everything.

(5) Endeavor to supply the electric furnace, which is a valuable asset to industry, only to those capable of properly applying it, and see that they can get competent operators.

C. A. BIRD.

Sessions Engineering Co.,  
Chicago, Ill.

*To the Editor of Chemical & Metallurgical Engineering*

SIR:—We have noted in your issue dated March 22 a letter from Mr. Traphagen on the electric furnace. It occurs to us that there are certain statements made in this letter which are of a very sweeping nature and appear to require correction.

Mr. Traphagen proceeds to disregard the question of phases, single and multiple arcs, arrangement of electrodes, and electrical systems. We would point out that the selection of the correct electrical system is the secret of the commercial success of an electric furnace installed for any particular process.

Mr. Traphagen inquires what wonderful cleansing power there can be in electric heating, which seems to us to indicate that he has entirely overlooked the fact that the basic lined electric furnace has no equal for the purification of common raw materials, or that the metallurgist may use slags of varying composition so as to make use of varying reactions at will, and that he has not to cope with contamination of the steel from impurities brought in by furnace gases. It may, therefore, be said that the great advantage of electric heat is really the entire absence of contaminating impurities.

In modern designs of furnaces an almost perfect air seal may be obtained by the use of specially designed furnace doors which automatically seal themselves on being lowered into position. Modern electric furnaces are fitted with extremely efficient electrode economizers which surround the electrodes at the point where they pass through the roof. Flame-muffling devices are also fitted to these economizers which also prevent considerable losses of heat.

We would like to point out that the electric furnace can deal with a far greater proportion of rusty or oxidized material than other processes, the only objection to a great proportion of rusty material being the consequent wear and tear upon the dolomite hearth, which of course would apply to any other basic process. Also it is a well-known fact that electric steel is surprisingly free from occluded gases.

We would like to dispute the statement as far as electric furnace practice in Europe is concerned that foundries melting with electricity are particularly liberal with aluminum when casting the metal. This is purely a question of skilled metallurgy.

We are quite in agreement with your note at the bottom of Mr. Traphagen's letter, but we are certainly of the opinion that electric furnace makers in America will be in a position to disprove some of Mr. Traphagen's statements.

ELECTRIC-METALS LIMITED,

London, England.

By H. NEEDHAM.

### Purple of Cassius Found in Bomb Washings

*To the Editor of Chemical & Metallurgical Engineering*

SIR:—In the paper by H. L. Olin and R. E. Wilkin, of the Department of Chemistry, State University of Iowa, Iowa City, Iowa, on "The Effect of Bomb Corrosion on the Accuracy of Calorimetric Determinations," published in *CHEMICAL & METALLURGICAL ENGINEERING* of April 12, 1922, the authors reached the conclusion that nickel was not a suitable metal with which to line the bombs. They demonstrated by experiment that nickel linings gave an error of 1.96 per cent up to 2.35 per cent, and recommend the use of some other metal better able to resist corrosion.

The writer has been using a calorimeter in which the linings were copper shells, heavily gold plated. It would appear that with this lining no corrosion could occur, since gold is resistant to the dilute acids formed by combustion—viz., sulphuric and nitric. But it is surprising to note that about half of the samples submitted for examination by this laboratory show that "purple of Cassius" is formed in the residues from the bomb washings, which are collected in water, preparatory to determining their sulphur content. The samples are of bituminous coal, mined principally in Pennsylvania and West Virginia. The purple pigment is rather deep in color in some coal samples, and in others it is not found. Its presence apparently indicates that the gold lining is slowly attacked during combustion of bituminous coal, although it is difficult exactly to account for its formation. The subject is open to some speculation and it may be possible that the small amount of potassium and sodium contained in the mineral matter of the coal, in the presence of the iron from the ignition wire and the nitrogen of the coal, forms alkali cyanides, which attack the lining.

It is interesting to observe that this purple of Cassius usually passes the first filtration and is precipitated with the barium sulphate in the determination of sulphur, giving a gold lake which is of a light violet color. Only a very small amount of gold is lost, however, since this lining, after about 1,500 determinations, is still in good shape and is not worn through to the copper. It is evident from this experience that the selection of an insoluble lining for bomb calorimeters is a difficult matter. Gold-plated linings are certainly a great improvement over nickel, but apparently even gold linings are subject to some corrosion, though very slight.

RANDOLPH BOLLING.

Naval Supply Station,  
U. S. Naval Operating Base,  
Hampton Roads, Va.

### Electrolytic Iron a Commercial Product

On page 639 of our issue for April 5, 1922, a footnote to Mr. McMahon's article on "The Manufacture of Electrolytic Iron" makes reference to a previously published article by Bradley Stoughton on "Electrolytic Iron a Commercial Product." The latter article appeared originally in *Iron Age*, Jan. 5, 1922, and credit should have been given that publication, since *CHEMICAL & METALLURGICAL ENGINEERING* merely reprinted it by permission.

### Concentrating Dilute Nitric Acid Solutions

In the article on "Concentrating Dilute Nitric Acid Solutions," by Clifford D. Carpenter and Joseph Babor, in our March 8, 1922, issue, the heading over the third column in Tables I, II and III should have been "Grams" instead of "Per Cent," as printed.

## British Chemical Industries

FROM OUR LONDON CORRESPONDENT

LONDON, April 16, 1922.

**B**USINESS in chemicals and fertilizers is better than for some time past and prices are well maintained except as regards soda ash and chloride of lime, for which substantial reductions have been made by manufacturers. The most significant feature is the apparent absence of complaints or grumbling as to the state of trade—a sure sign that good business is being unobtrusively transacted and that the forward position is considered favorable. Even the recent depreciation in the mark and the revisions made in the safeguarding of industries act have not affected prices. The demand for fertilizers is still quite phenomenal and is partly due to the fact that buyers held off until the last moment in the hope of obtaining more favorable prices. Superphosphate is in strong request, while sulphate of ammonia is almost unobtainable. The market in coal-tar products is at last improving and cresylic acid is particularly firm.

### OFFICIAL REPORT EXPECTED ON LOW-TEMPERATURE CARBONIZATION

It is understood that the Fuel Research Board of the Department of Scientific and Industrial Research is about to publish a voluminous report on the experimental and technical development of low-temperature carbonization, and that the full results obtained at H. M. Fuel Research Station will be discussed at length. A preliminary report was issued by the board over 3 years ago and it is felt that some of the information which had accumulated was held back too long and to the detriment of those concerned with the commercial development of the industry. Low-temperature carbonization propositions have always been regarded with scepticism in this country and now that several systems are within measurable distance of success, a stimulus has been given to high-temperature carbonization by the researches of Messrs. Sutcliffe and Evans, who showed that a free-burning smokeless fuel can be obtained if the coal is briquetted under special conditions before carbonizing. It is stated that only 12 cwt. of the new fuel is required to produce 1 ton of pig iron.

### RIVAL LOW-TEMPERATURE SYSTEMS DISCUSSED AT CARDIFF

The South Wales Institute of Engineers held a symposium at which almost every system except the "coal-ite" retort was discussed. The Nielsen system of carbonization in a rotary retort using the sensible heat in producer gas generated by part of the resulting semi-coke is of particular interest and a large plant is under construction for India. The Fusion Corporation's report is also noteworthy for its simplicity, low cost and prevention of scale and "balling." One consequence of progress in this type of plant is renewed interest in oil shale retorting proposition, it being now realized here as in America that shale oil will play its part in supplying the ever-increasing demand for oil fuel and motor spirit. The Scottish shale industry was mainly dependent upon its revenue from sulphate of ammonia and paraffine wax, but the commercial future of shales and torbanites found in Great Britain, Australia, Esthonia and elsewhere will depend not only on successful methods and research but upon educational

<sup>1</sup>See *Engineering*, March 25, 1922.

work and propaganda in regard to the marketing of the products. Reference has been made in these notes to English Oilfields, Ltd., a company which has so far been unsuccessful on account of the high sulphur content of the oils obtained and on account of retorting difficulties. There are indications that both obstacles will shortly be overcome.

### A NEW BUYER'S GUIDE FOR THE CHEMICAL TRADE

S. Davis & Co. are preparing for issue in July a chemical trade directory on somewhat original lines, which may be more truly representative and reliable than those previously obtainable. The normal practice has been to obtain payment not only for the insertion of names of firms but also to make a fairly substantial charge for supplying the directory itself to users, and the result has been that chemical directories have circulated mainly among the advertisers themselves. It was also found that under some classifications either some of the largest suppliers had not thought it worth while to advertise or else the list was chiefly composed of unimportant manufacturers or agents and traders. The present buyers' guide is to have a guaranteed circulation of 10,000 copies among actual buyers, will be issued free of charge and a certain number of entries will be given free to each manufacturer whether he advertises or not.

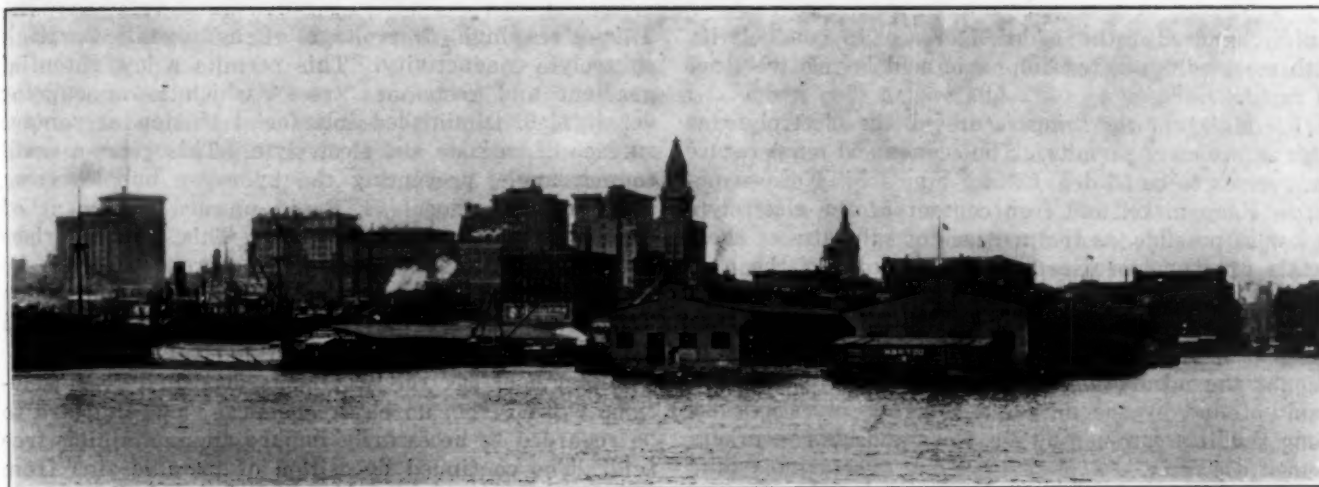
### AUTOMATIC ELECTRIC WELDING

The Cyc-Arc process, which is being developed by Handstock, Ltd., is attracting considerable attention not only in the shipbuilding industry but also for chemical and metallurgical equipment and for other special applications. By this process metal studs, rods and tubes can be automatically and directly welded on to sheets, tubes, forgings, etc., by electrical means and without the use of fluxes. The process is applicable not only to brass and other alloys welded on to iron and steel, but recently it has also been possible to weld high-speed tool steel tips on mild steel shanks, thus effecting a considerable saving in the cost of lathe tools. The strength of the weld is equal to or greater than the original strength of the material and large studs can be welded at the rate of about forty per hour. A process of this kind should prove useful in cases where the maintenance of gas and water tightness is essential and it therefore has possibilities in connection with the design and rapid construction of chemical plant.

### GENERAL NOTES

Among recent decisions in the safeguarding of industries act may be mentioned that of liquid sulphur dioxide, which was held to be free of duty because no greater degree of purification was necessary than if the gas had been used in the manufacture of sulphuric acid by a catalytic process. An unsuccessful attempt was also made to remove the duty on mucic acid on account of its impending manufacture on a large scale by the Acree process of the International Products Co., at Eureka, Mont. The proposal to remove the duty from synthetic camphor, chiefly used by the British Xylonite Co., is still under consideration. Rumors persist regarding the financial reconstruction of the British Cellulose & Chemical Manufacturing Co., and although these have been officially denied, it is fully expected that an arrangement with a Continental firm will shortly be made. Sir Ernest Rutherford is to be the new president of the British Association.





A PORTION OF BALTIMORE'S SKYLINE

Photo by J. F. Hughes Co., Baltimore

## Baltimore Meeting of American Electrochemical Society

Report of Technical Sessions Comprising a Symposium on Electric Cast Iron and One on Electrodeposition—Honorary Membership Conferred on Dr. Carl Hering—Dr. C. G. Schluederberg Elected President—Fall Meeting at Montreal Sept. 21-23

THE American Electrochemical Society held its forty-first general meeting at Baltimore, April 27 to 29 inclusive. It was one of the very best meetings the Society has ever held. The attendance was exceptionally good, the technical sessions were very well conducted, there being an unusual amount of animated discussion. The social features were most attractive and enjoyable due to the untiring efforts of the local committee under the chairmanship of William H. Boynton.

Thursday morning and afternoon were given over to the symposium on Electric Cast Iron, one of the best symposiums ever held by the Society, being attended by many engineers of international repute who took very active part in the discussion. This symposium was reported at length in our last issue.

### Friday Sessions

#### A PLEA FOR RATIONAL INTERPRETATION OF HYDROGEN-ION MEASUREMENTS

Dr. William C. Moore of the Research Laboratory of the U. S. Industrial Alcohol Co., Baltimore, reported that he had found that in many biological systems hydrogen-ion regions are of more importance than actual hydrogen-ion concentrations. Thus, invertase has a flat maximum of activity in the range for  $[H_+]$   $1 \times 10^{-4}$  to  $1 \times 10^{-5}$ , and, concurrently, fermenting molasses mashes show within this range no relation between hydrogen-ion concentration and yield of ethanol. He made a plea to express hydrogen-ion concentrations in any one set of measurements in terms of a common denominator instead of as pH values, which for chemical work sometimes seem inconvenient.

Discussing Dr. Moore's paper, Clarke E. Davis of the Research Laboratory of the National Biscuit Co. showed curves based on actual titration of phosphoric

acid. The second end point, contrary to Clark,<sup>1</sup> was found to be more than twice the first by an appreciable amount. This result is not accidental, but has shown itself in repeated titrations and by different investigators. Mr. Davis very much favored the Sorensen method of expressing results. Dr. Blum of the Bureau of Standards emphasized that usually the intensity factor was much more important than the quantity factor. C. P. Madsen said that in the case of nickel-plating solutions it was difficult to obtain concordant pH values.

### ELECTROLYTIC COPPER AND ZINC

"The Conductivity of Copper Refining Electrolytes" was the subject of a highly interesting paper by Prof. E. F. Kern and M. Y. Chang of Columbia University. The specific conductivities of solutions of sulphuric acid, copper sulphate, and of mixtures of sulphuric acid and copper sulphate were determined at 25 deg. C., 40 deg. C. and 55 deg. C. The concentrations of the solutions were 5, 10, 15 and 20 grams per 100 c.c. The effects of the presence of arsenic, nickel sulphate and ferrous sulphate upon the conductivity of a copper-refining electrolyte were determined, showing that the presence of arsenic does not appreciably depress the conductivity, whereas the presence of nickel sulphate and of ferrous sulphate depresses the conductivity very much.

The conclusions drawn from the results of these determinations are:

(a) The copper content of refining electrolytes should be kept between 30 and 35 grams per liter (approximately 120 to 140 grams  $CuSO_4 \cdot 5H_2O$ ) and the free sulphuric acid as high as economy permits up to 175 grams per liter. With higher free sulphuric acid content the solubility of copper sulphate decreases

<sup>1</sup>"The Determination of Hydrogen Ions," p. 32.

rapidly, and also the added increase in conductivity with more concentrated sulphuric acid is relatively not so rapid.

(b) Maintain the temperature of the electrolyte as high as economy permits. The economical temperature limit seems to be 55 deg. C.

(c) Keep nickel and iron content of the electrolyte as low as possible, as the presence of sulphates of these metals greatly depresses the conductivity of the electrolyte.

Lawrence Addicks of New York, in commenting upon the paper, felt that it was important to take into account the adsorption factor, which may change the results found by the authors. Further investigations along the lines pursued by Dr. Kern and his co-workers seemed desirable.

"Electrolytic Zinc and Hydrogen Overvoltage" was investigated by U. C. Tainton of the Bunker Hill & Sullivan Mining Co. of San Francisco.

If there be one factor in the production of electrolytic zinc which would seem to be firmly established, it is that relating to the necessity of a pure electrolyte. From Mylius and Fromm onward, the most gratifying unanimity prevails in the literature in this regard. Laist says, "Pure solution is the greatest single factor in the production of electrolytic zinc." Hansen, "Impure solutions invariably yield imperfect cathodes." Hall states, "The requirement, and I use it in the singular, for zinc electrolysis, is zinc sulphate, and zinc sulphate only." Siemens and Halske, "Every other metal and even carbon must be completely excluded."

These are high ideals. The production of pure zinc sulphate solution is no easy matter.

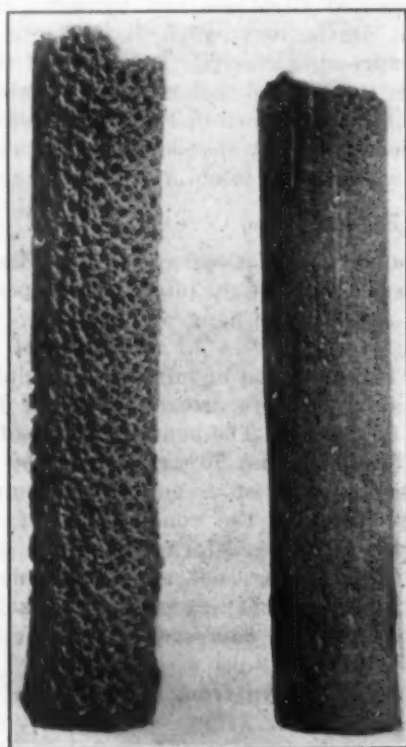


FIG. 1.  $\times 1.5$

Left—Zinc deposit from well purified solution, almost free from colloid, showing effect of adhering hydrogen bubbles.  
Right—Zinc deposit from same solution but with trace of gelatin added.

Mr. Tainton found the following conditions indicated as favorable to the production of good zinc deposits from impure acid solutions: 1. High current density.

This gives high overvoltage of hydrogen. 2. High electrolyte conductivity. This permits a low potential gradient and restrains "trees" which lower current density. 3. Diminished interfacial tension at contact surface of cathode and electrolyte. This gives a small contact angle, preventing the hydrogen bubbles from adhering to cathode. 4. Rapid upward movement of electrolyte past cathode surface. This usually arises automatically if sufficiently high current densities be employed. 5. Presence of some addition agent which will restrain crystalline growth of cathode deposit and raise overvoltage of impurities.

Commercial electrolytic zinc is deposited from solutions which, from an electrochemical viewpoint, are to be regarded as necessarily impure and containing free acid. The continued deposition of metallic zinc from such solutions depends on the maintenance of a high hydrogen overvoltage at all points of the cathode surface. This is attained by the maintenance at all points of a substantial current density, which, in turn, depends largely on the smoothness of the deposit. By sufficiently increasing the current density the hydrogen overvoltage for all metals examined (lead, cadmium, copper, iron, nickel, cobalt, antimony) may be made to exceed the potential of zinc on the hydrogen scale. This does not accord with figures obtained by the commutator method of measuring the variation of hydrogen overvoltage with current density, and it is believed that this method is unreliable. The overvoltage of the alloys examined lies between the overvoltages of their constituents. In the case of zinc deposits containing impurities, the overvoltage is very high as long as the zinc surface is clean and growing. However, the overvoltage of an impure, corroded zinc surface is found to be very low, and so once corrosion begins (at a point of low current density), it tends continually to spread. The function of colloidal matter such as gelatin in the electrolyte is to raise the overvoltage of hydrogen. It also lowers the contact angle of the hydrogen bubble, thus preventing adhesion of bubbles to the cathode surface. It tends to restrain crystalline structure of the deposit. All these factors tend to maintain smoothness of deposits. Practical work indicates optimum conditions to be a free acid concentration of about 250 to 300 grams per liter with a current density of about 100 amp. per sq.ft., and the presence of a minute quantity of gelatin or similar colloidal matter in the solutions.

#### EXPERIMENTS WITH A.C. IN D.C. ELECTROLYSIS

W. B. Jones of Buffalo submitted a detailed account of an investigation extending over several years. Potentiometer measurements of the potential difference of a lead cathode and a hydrogen electrode were made over a cycle of 0.04 second, during which combined alternating and direct currents flow through the electrode. This potential was plotted against the current flowing, and a graphic correction made for the true overvoltage. When plotted against coulombs, interesting results were found. These indicate the formation of stable and unstable compounds, as films on the electrode, as the cause of overvoltage. Measurements with intermittent direct current give the approximate stability of the lead hydride when the current is cut off. The potential of the hydride drops in this case about 0.6 volt in 0.08 second. Indications are that there is a lower hydride that is quite stable. An approxi-



mate calculation of the higher hydride formula gives about  $PbH_3$ .

The maximum overvoltage attained during cathodic action is only slightly lowered by superimposing increasing amounts of alternating current upon the direct current.

#### ELECTROLYTIC CORROSION

Dr. Robert J. McKay of the Mellon Institute studied "The Corrosion by Electrolytic Concentration Cells." He found that the corrosion could be very much accelerated in the case of a homogeneous metal in acid solutions, due to differences in concentration of dissolved materials in the solution. Copper is dissolved from Monel metal tie rods of pickling tanks due to leaks between the timbers.

A cell was set up with Monel metal electrodes in sulphuric acid (60 grams per liter), the solutions around the two electrodes being separated by a porous cup. The electrodes were connected in external circuit through a galvanometer. When the solution around one electrode was stirred and the other permitted to remain quiet, a deflection of the galvanometer was obtained showing a flow of current through the cell, the agitated electrode being the anode. The current continued as long as the stirring was kept up. If the solution at the other electrode was now stirred and that first stirred permitted to come to rest, the current was reversed. It was also found possible to produce a current with both solutions agitated, by making the agitation at one electrode more violent than at the other. The direction of the current was always such that the more violently agitated electrode was the anode.

Dr. W. C. Moore pointed out that in the past too little attention has been paid to the dissolved air in the acid electrolytes. Very likely this dissolved air played a very prominent rôle in effecting the speed of corrosion. Referring to Dr. McKay's observation on the effect of stirring, Dr. Fink cited the problem of finding a suitable metal or alloy for acid pumps. An alloy may be very resistant to corrosion when quietly suspended in an acid solution and yet this same alloy is a complete failure when used in a pump for this same acid solution. Unfortunately, many of our investigators draw conclusions as to the merits of an alloy without submitting it to actual practical tests. Dr. C. J. Thatcher of New York described tests made on platinized electrodes. The potential readings were very largely dependent upon the rate at which the gas, O or N, was supplied to the electrode. Burnham E. Field suggested that some of Dr. McKay's results might be interpreted by taking into account the difference in oxygen concentration of the solution directly in touch with the tie rod and that some distance away. George B. Hogaboom said that in investigating the speed in pickling solutions he had obtained concordant results by resorting to the "alternate in and out" method of testing samples—that is to say, exposing the samples alternately to the solution and then to the air.

#### THE EFFECT OF IMPURITIES ON STORAGE BATTERIES

Mrs. Helen Gillette Weir of the Prest-O-Lite Co. gave a highly interesting account of the results of her investigations on the effect of impurities in the sulphuric acid of batteries. The presence of certain amounts of impurities in the electrolyte of a storage cell was studied to ascertain the effect on the electrical per-

formance of the cell. The extent of the injury was determined by comparison of the electrical characteristics of the cells before and after contamination and by further comparison with normal cells included in the same series of tests. Of the metals tested only manganese and platinum produced intense injury when present in minute quantities. With these two exceptions, none of the impurities tested had a lasting effect on the cell voltages or on the ampere-hour capacity of the charged battery. In various amounts certain of the impurities were found to be injurious, either by increasing the rate of self-discharge or decreasing the life of the plates. Zinc, nickel and tin in small percentages were not detrimental to any of the electrical characteristics. The results of these tests indicate that, contrary to the general belief, most of the common metals and acids may be present in appreciable quantities without causing serious injury to the cell.

#### The Technical Man as a Citizen

##### PRESIDENTIAL ADDRESS BY ACHESON SMITH

We expect shortly to print this admirable address in full and give here only a few excerpts. "This is the age of the engineer, but it is possible that we do not understand the full significance of that phrase. The present advanced state of civilization is mainly due to the technical men. In view of what has been accomplished by the engineer, it may sound strange to say that he is seeking recognition, but such is the case. What can the engineer do to procure such recognition? The leaders in the country are those who do a citizen's duty and a little more, over a term of years, and as a result find themselves the influential men in their community. Under a system of government where the illiterate and men of low ideals have an equal voice with the educated and men of high ideals, the only thing that can prevent liberty from destroying itself is intelligent leadership. Here is an opportunity for the engineer."

#### Saturday Sessions

##### HYDROGEN AND OXYGEN

The first paper of the Saturday morning session was entitled "The Production of Hydrogen by the Use of Silicon and Sodium Hydroxide." The author, E. R. Weaver of the U. S. Bureau of Standards, described the generation of hydrogen by the "silicol" process, which has been found very adaptable for military and naval purposes. The non-combustibility of the materials used insures safety of transportation. The rate of reaction of ferrosilicon with sodium hydroxide, in the subsequent generation of hydrogen, depends upon the composition of the material, its fineness, the concentration of the sodium hydroxide and dissolved silicon in solution, and the temperature. The plant, of a small size, low cost and of high productive capacity, consists essentially of three parts: The solution tank, the generator and the washer. The merits of the process and comparative cost figures for materials were given.

The only considerable disadvantage of the method is its cost. With 85 per cent ferrosilicon costing \$200 per ton and sodium hydroxide costing \$4 per 100 lb., the cost of materials for 1,000 cu.ft. of hydrogen at 60 deg. F. and 30 in. pressure will be \$4.60 for ferrosilicon and \$1.50 for sodium hydroxide, a total of \$6.10. When transportation and handling charges for the materials are added, the cost for materials alone is not likely to be less than \$7 per 1,000 cu.ft. The labor and

capital charges on any plant which is used steadily become negligibly small. In any case they will probably be less than for any other method of generating hydrogen.

William G. Allan, research engineer of the Toronto Power Co., next presented a detailed account of the "Electrolytic Generation of Hydrogen and Oxygen, With Special Reference to the Utilization of Off-Peak Power." Mr. Allan discussed at length the economics of the problem and showed a series of curves which greatly facilitate cost computation. The utilization of "off-peak" power, for the purpose of generating these gases at cheap prices with a view to their use in large quantities in the chemical or other industries, was advocated. Special mention was made with a brief description and some illustrations of a new type of electrolytic cell, designed and developed by Mr. Allan. Basic constants and data used in calculations were given, and comparisons of the chief characteristics of the new cell with those of other existing types were submitted.

The Allan cell is adapted to operate under widely varying conditions of current density per square inch of projected electrode area, without too great a sacrifice of energy efficiency. It is thus adapted for operation at different rates of gas production, according to the cost of power at any particular time of a 24-hour day, during which it is conceivable that a power consumer has contracted for power under two or more different rates. The higher the rate of gas production the less the influence of the fixed charges in the total cost of the gases, while depreciation does not increase at a rate which is proportionate to the rate of gas production. As a result, at high current densities, the cost of power becomes the major item in the total costs of the gases, and where power is cheap, as in the case of "off-peak" power, the gases may be produced very cheaply, and many processes which up to the present have been excluded from consideration now come at least within the range of possibility, while others are definitely placed in the class of commercially feasible processes. Mr. Allan showed the influence and relative importance of the various items entering into the costs of the gases, and finally mentioned the many present and future possible uses of the two gases.

V. T. Stewart of Montclair, N. J., pointed out that

the usefulness of hydrogen is greatly hampered by its outstanding property—namely, being the lightest known substance. He referred to the various applications of hydrogen, among others the use of the gas for certain metallurgical operations. Here hydrogen is of distinct advantage on account of its comparative inertness. In the annealing of ingot iron, the presence of an atmosphere of hydrogen modifies the properties of the metal enormously. An atmosphere of hydrogen is of distinct advantage in the cooking of certain kinds of paper pulp. The resulting stock is stronger and requires less bleach. Dr. Fink emphasized the importance of hydrogen as a reducing agent in many metallurgical operations. The high cost of electrolytic hydrogen as compared with coke or other carbonaceous reducing agents was often more than offset by the much lower operating and maintenance charges; due to the low temperatures at which many of the hydrogen reductions can be carried out, the furnace construction is simpler and less expensive and the labor costs are small.

Dr. Carl Hering of Philadelphia described experiments he carried out, electrolyzing acidulated water in a bomb. Pressures of about 34 atmospheres were attained. The potential dropped to 0.3 volt and apparently the gases at the electrodes were not evolved according to Faraday's law. Dr. Fred T. Kaelin of the Shawinigan Water & Power Co. emphasized the importance of Mr. Allan's contribution and mentioned many new uses for the gases H and O.

#### THE RADIUM CONTENT OF PRODUCTS OF LOW ACTIVITY

Dr. Victor F. Hess, chief physicist of the U. S. Radium Corporation, described a very ingenious but comparatively simple method he developed for the detection and estimation of radium when present at very low concentrations. Hess' method is a thousand times more sensitive than the best method known heretofore. When carnotite or other materials are filled into a space between two concentric spheres, the gamma ray effect in the center of the inner sphere can be calculated. This formula was taken as the basis of a direct method of determining the radium content of these substances. The samples were filled in wooden containers which were closed hermetically. The gamma ray electrometer was introduced into the center. The observed ioniza-



VIEWS OF INTERESTING SECTIONS OF BALTIMORE

Photos by J. F. Hughes Co., Baltimore



tion, expressed in absolute units (E.S.U.) reduced to normal pressure and temperature, multiplied by certain constants, gives directly the radium content per gram of material.

The method is sensitive enough to give correct figures for material with 10<sup>-3</sup> grams radium per gram of material. It is very simple, and requires no chemical treatment of samples before the measurements.

The results on ore samples were compared with the results derived from the chemical analysis of the uranium content and were found to be in good agreement. In discussing Dr. Hess' paper, Dr. S. C. Lind, chief chemist of the Reno Station, Bureau of Mines, pointed out the great importance of possessing a method as sensitive as that devised by Dr. Hess. It finds practical application in the concentration of radium-bearing ores where chemical analysis and control fail. Furthermore the Hess method has a very wide application and does not require an expert, as in the case of the emanation method. Dr. Harlan S. Miner of the Welsbach Co. regretted that Hess' method was not applicable to thorium products.

#### ELECTROMAGNETIC MOTIONS IN ELECTRIC FURNACES

Dr. Carl Hering discussed the new electromagnetic law he proposed some months ago. The new law is: In a system of electric current-carrying conductors any, and only such, mechanical motions of its conductors will tend to take place as will generate a counter e.m.f. somewhere in the electrical circuits. But whether or not this electrical version is the best one, the general law of nature on which it is based ought to apply to all electromagnetic systems as well, and it seems to follow in any case that our older restriction to only one possible force was unjustifiable. In general, according to the above law, any desired motion of the conductors (especially of the mobile liquid conductors or arc vapors in electric furnaces) can probably be produced electromagnetically by the current itself, if such a motion would produce a counter e.m.f. somewhere in the circuit, if the necessary freedom of motion exists, and if there is not also produced thereby somewhere else in the system an equal and opposite effect. The original source of energy must of course be able to provide the additional voltage to overcome this counter e.m.f.—that is, it must provide the energy for such motions. While theoretically there may be no limit to the intensity of the forces thus produced, in practice there is. A few pounds per square inch will, however, produce quite rapid motions of even heavy molten liquids. Strong forces require large currents, which tend to generate heat; such forces are, therefore, limited largely to furnaces in which this heat is useful.

#### GAS PRESSURES IN TUNGSTEN VACUUM LAMPS

The Research Laboratory of the Westinghouse Co. has been studying the methods for the "Measurement of Pressures in Vacuum Type Electric Lamps." Dr. Duncan MacRae, research physical chemist, reported upon a new and simple method he devised for determining these low pressures.

The tip of the lamp is removed in an evacuated glass system by means of an iron plunger electromagnetically operated. The resulting pressure is measured with a McLeod gage and the pressure in the lamp before opening is calculated. The results of measurements on unflashed, flashed and life-tested lamps are given.

Dr. C. J. Thatcher, of New York, maintained that on

the basis of his own experience red phosphorus does not combine with oxygen at very low pressures without "flashing" or ionizing the phosphorus. Accordingly the gradual rise in pressure after removing the tip cannot be accounted for by the reaction  $2P + 5H_2O = P_2O_5 + 5H_2$ . Dr. C. C. Paterson of the British General Electric Co., writing from London, suggested that this gradual rise in pressure was due to the formation of  $PH_3$ , on the basis of experiments carried out by his associates. "If Dr. MacRae's apparatus was not thoroughly dry before the tip of the lamp was broken, we should expect to find a generator of gas when it is broken." Dr. Paterson also emphasized the advantage of the Pirani over the McLeod gage.

#### ORTHO-AMIDOPHENOL, ELECTROLYTICALLY PRODUCED

The subject of organic electrochemistry has been interesting an ever-increasing number of members of the Society. Plans are under way for the formation of an organic electrochemistry division.

Oliver W. Brown and J. C. Warner, of the department of chemistry, Indiana University, investigated the commercial possibilities of the "Electrolytic Preparation of Ortho-Amidophenol."

All reductions of ortho-nitrophenol to ortho-amidophenol were carried out in caustic soda solutions and at a copper gauze cathode. Results of experiments show the effect of current density, concentration of caustic soda and ortho-nitrophenol in the cathode liquor, and temperature at different current densities on current efficiency and material yield. The quantity of amine produced was determined by a method involving diazotization with standard sodium nitrite.

As best conditions for the electrolytic preparation of o-amidophenol from o-nitrophenol in alkaline solution and at a copper cathode, the following conditions are recommended. Start the reduction with a cathode solution of 15 per cent NaOH containing 3 to 5 grams of o-nitrophenol per 100 c.c. Maintain a temperature slightly below the boiling point and use a current density of 10 amperes per sq.dm. When one-half of the o-nitrophenol has been reduced, add one-half the original amount of the nitro compound. After another such period, add a similar amount of o-nitrophenol. Continue the reduction with a current density of 10.0 amperes per sq.dm. until the concentration of o-nitrophenol has dropped to about 1.5 grams in 100 c.c., then lower the current density to 4 to 5 amp. per sq.dm. and the temperature to 60 to 70 deg. C. and continue the electrolysis until the concentration of o-nitrophenol has dropped to 0.8 gram per 100 c.c. Finish the reduction with a current density of 1 to 2 amperes per sq.dm. Under these conditions, a material yield and current efficiency of 97 to 99 per cent should be obtained.

Commenting upon Brown and Warner's method, Dr. C. J. Thatcher questioned whether it would be practical on a large scale, as it was very difficult to electrolyze at or near the boiling point. Furthermore, he knew of no diaphragm which would resist the destructive action of hot NaOH solutions for any length of time.

#### ELECTRODEPOSITION OF METALS

A very animated discussion was aroused by four papers dealing with electrodeposition. The first paper, by W. E. Hughes of London, was headed the "Idiomorphic and Hyp-idiomorphic Structures in Electrodeposited Metals."

By idiomorphic structure is meant the structure

which results in a mass of rock or deposited metal when the crystals composing it have had the opportunity to develop their external forms freely.

By hyp-idiomorphic structure is meant the structure resulting from the fact that the component crystals (or the majority of them) have not had the opportunity to develop their faces and edges freely, but, owing to mutual interference, have been compelled to take their shapes from their surroundings.

It is suggested that these definitions are sufficient for indicative and descriptive purposes, though they may not be as exact as might be.

Microphotographs were shown of electrolytic copper, zinc and iron. One of the electrolytic iron photographs clearly demonstrated how upon increase in the free acid concentration of the electrolyte the crystal structure could be made to change from an idiomorphic to a fibrous one and then into a hyp-idiomorphic one by decreasing the acid concentration.

Briefly, the hyp-idiomorphic structure is that within the mass of deposited metal which corresponds to an idiomorphic structure on the surface. The former grows into, or becomes, the latter as deposition continually proceeds. The relation is analogous to that obtained between normal within and coarsely crystalline on the surface, or, again, between fibrous within and very finely crystalline, or apparently amorphous, on the surface.

"The Acidity of Nickel-Depositing Solution" was carefully investigated by M. R. Thompson of the Bureau of Standards. A simple method was applied to the quantitative measurement and control of the pH of nickel-depositing solutions by means of indicators. The pH characteristics of several types of nickel-plating solutions have been studied. Preliminary observations were made on the general effect of pH on the appearance and structure of nickel deposits and the range of pH used in commercial nickel plating was investigated. A plea was made for the inclusion of complete pH data in all future publications dealing with research on the electrodeposition of such metals as nickel, cobalt and iron.

Charles H. Proctor, of the Roessler & Hasslacher Co., heartily supported Mr. Thompson in his opinion that the pH values can be used as a control of nickel solutions. George B. Hogaboom, of the Scovill Mfg. Co., however, pointed out at length that the pH values were not always reliable and frequently very misleading. He found that pH readings are affected not merely by the hydrogen-ion concentration but also by the metal-ion concentration of the electrolyte. Two nickel sulphate solutions might give the same pH readings and yet their composition and the electrodeposits obtained be totally different.

Dr. E. A. Vuilleumier briefly described his contractometer<sup>1</sup>. A. K. Graham, of the University of Pennsylvania, commented upon the irregularity in the thickness of the deposit on the platinum plate of the contractometer and suggested that this irregularity might effect the bending of the plate. But Dr. B. E. Field of Niagara Falls maintained that such would not be the case. C. P. Madsen recited at great length the deceptive results obtained with the pH methods applied to nickel electrolytes. Impurities present in quantities as small as 1 part in a million were often enough to cloud the readings. Very much more important than

the pH reading of a nickel electrolyte was a knowledge of the composition and properties of the anodes used. In defense of the pH method it was pointed out by Mr. Madsen and others that, as a rule good and comparable results were possible with dilute solutions and not with concentrated solutions such as are used in plating operations.

Prof. W. G. Wood and T. Fuwa reported on an investigation carried out at the Massachusetts Institute of Technology on "The Throwing Power and Current Efficiency of Zinc-Plating Solutions." The subject is of great commercial importance. It was found that zinc-plating baths, the principal constituents of which are sulphate, fluoborate or zincate, show small throwing power, although satisfactory deposits may be obtained with sulphate baths when anode and cathode are plane and parallel to each other. Alkaline cyanide baths, having the composition

Sodium cyanide, grams.....	53.2
Zinc cyanide, grams.....	59.2
Sodium hydroxide, grams.....	43.8
Sodium carbonate, grams.....	9.5
Aluminum sulphate, grams.....	4.7
Lignol, grams.....	11.8
Water, c.c.....	1,000

show high throwing power, moderately high efficiency, very low voltage and give continuously good results when operated under proper conditions. The proper conditions for operating the above alkaline cyanide bath continuously were determined and found to be as follows: C. D., 2 amp. per sq.dm.; temperature, 40 deg. C.; stirring, moderate; anode, composite of zinc and Duriron, the Duriron surface forming 30 per cent of the total anode surface. The use of an addition agent is necessary. Glue is fairly satisfactory, but "lignol" was found to be a better and cheaper material.

Mr. Hogaboom, in discussion, said that he, as a plater, interpreted the term "throwing power" to mean the ability of a solution to deposit metal in deep recesses. For example, certain nickel solutions will give a uniform deposit inside a shaving soap box (1 in. diameter x 3 in. deep) without an anode inside the box. Mr. Proctor found cyanide solutions better than sulphate solutions for zinc plating. Dr. Blum pointed out that there was a so-called primary distribution of the current which was practically the same for all electrolytes, no matter whether cyanide or sulphate. "Throwing power" refers to a deviation from this primary distribution. He felt that eventually we may be able to predict the throwing power of a solution on the basis of cathode potential current density and current efficiency of an electrolyte. Work along these lines is now being carried out at the Bureau of Standards. Copper cyanide is better than zinc sulphate. Agitation and heating of the electrolyte will decrease the throwing power. Mr. Proctor displayed an iron tube, about 1/4 in. in diameter, which had a uniform zinc plate on the inner wall. Mr. Hogaboom emphasized that with an electrolyte having good throwing power tubes would be plated evenly inside and out no matter how placed in respect to the electrodes.

#### WINNIPEG AS AN ELECTROCHEMICAL CENTER

The concluding paper of the Saturday morning session was entitled "A New Hydro-Electric Power Development of Importance to the Electrochemical Industry," by M. C. Gilman of Winnipeg. An important low-cost hydro-electric power development is nearing completion in the Winnipeg district. Very soon there will be available 320,000 hp. and more than 250,000 hp.

<sup>1</sup>See *Mineral Industry*, October, 1921, p. 419; March, 1922, p. 108.



remaining for future requirements. The third plant, nearing completion, will represent an outlay of but \$70 per horsepower, or decidedly less than at Niagara Falls. Raw materials for the production of abrasives, cyanamide, ferrosilicon, ferro-alloys, cobalt alloys, magnesium, aluminum, etc., are readily accessible. Copper and nickel deposits are plentiful. On one property 20,000,000 tons of this ore has been blocked out. Large deposits of gold-bearing molybdenite deposits have been located near High Lake. High-grade iron ore is also available within comparatively short economic rail haul.

#### Business Sessions

##### DR. HERING MADE AN HONORARY MEMBER

At the meeting of the board of directors Dr. Carl Hering was unanimously elected an honorary member of the Society. Dr. Hering was one of the founders of the Society and has been one of the most active and loyal members ever since. He has a world-wide reputation as an electrical engineer. He was born in Philadelphia, March 29, 1860, and is a doctor of science of the University of Pennsylvania. He is a Chevalier Légion d'Honneur, past president of the American Electrochemical Society, of the American Institute of Electrical Engineers, of the Philadelphia Engineers Club and an honorary member of the New York Electrical Society. He has contributed lavishly to the scientific world and has published over 400 scientific and technical papers. He is the inventor of a number of electric furnaces and other apparatus. His "Conversion Tables" are an international handbook. His scientific interests are most diverse. He can discourse on the proper cultivation of mushrooms as freely as he can on the theory of Einstein or on the Steinmetz equations. The formal ceremonies, conferring the honorary mem-

bership on Dr. Hering, took place on the evening of April 27 at Johns Hopkins University, President Acheson Smith making the presentation.

##### JOSEPH RICHARDS MEMORIAL FUND

Several members of the Society suggested raising a prize fund and devote the interest of it to the encouragement of original research and original contributions to the *Transactions* of the Society. A committee was appointed to investigate the matter and report back to the next board meeting.

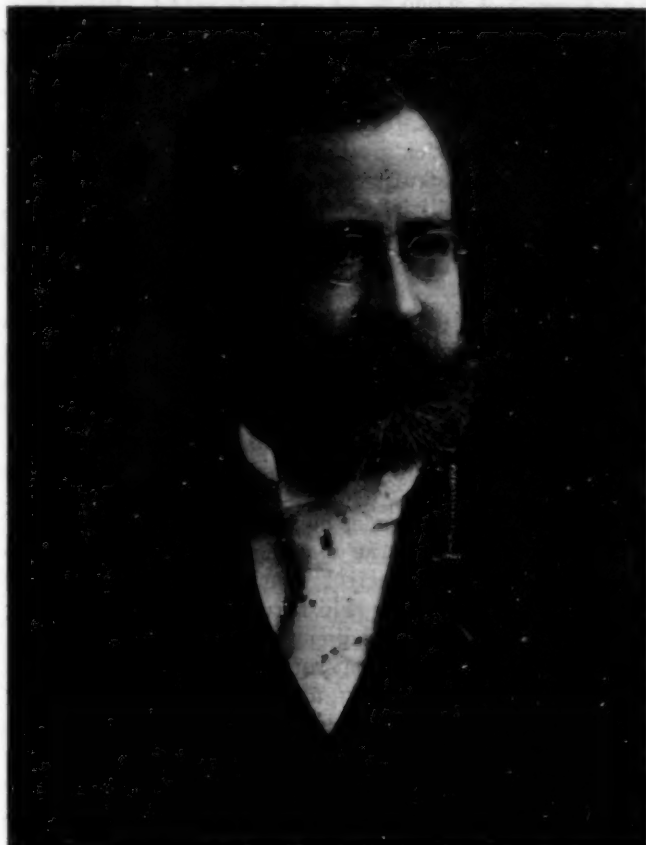
##### NEW SUBJECTS FOR FUTURE MEETINGS

The following subjects were suggested for discussion at future meetings of the Society: For the fall meeting, Montreal, Sept. 21, 22 and 23, 1922, "Industrial Heating," which subject will be in charge of the Electrothermic Division, Bradley Stoughton, New York, chairman. The second subject for the Montreal meeting will be "Electrical Endosmosis," in charge of F. A. Lidbury, Niagara Falls. "Industrial Heating" will be largely concerned with the details in the construction and design of furnaces and ovens for low-temperature operation, such as are used in heat-treatment, glass annealing, ceramics, etc. The question of the selection of resistor, heat transfer, specific heat of materials, etc., will likewise be included. For the spring of 1923 meeting two subjects have been selected: "The Potential and Overvoltage of Aqueous Solution," in charge of Prof. W. G. Horsch, Massachusetts Institute of Technology; and "The Production and Applications of the Rarer Metals" (such as Zr, W, Mo, Ta, Co, Ti, etc.), in charge of the Electrothermic Division.

##### ELECTION OF OFFICERS FOR 1922-1923

The new president of the Society is Dr. C. G. Schluederberg of the Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa. Dr. Schluederberg was graduated from the School of Electrical Engineering of Cornell University in 1902 and in that year entered the employ of the Westinghouse Electric & Manufacturing Co., taking up the company's college graduate apprenticeship course. After a year in the shops, he was transferred to the Pittsburgh sales office. In 1905 he entered upon company research work, doing electrochemical as well as post-graduate work at Cornell University. He continued at Cornell until 1908, when he completed this work and was awarded the degree of doctor of philosophy and a degree in chemistry. He also spent some time abroad on special investigations and subsequently became associated with the Carnegie Steel Company in electrical and metallurgical work. In 1910 Dr. Schluederberg returned to the Westinghouse company as commercial engineer in the supply department and from 1911 until 1915 was in charge of switchboard work. Since 1915 he has been assistant to the manager of the supply department, in charge of various phases of its work, including central stations, railways, syndicates, licenses and educational work. He is a member of a number of engineering and other societies and has been particularly active in the American Electrochemical Society. He has published a number of articles covering original research work on electrochemical activities and developments.

The new vice-presidents are H. C. Parmelee, editor of *CHEM. & MET.*; Albert H. Hooker of Niagara Falls, and W. S. Landis of the American Cyanamid Co. The new managers are A. T. Hinckley of the National Car-



CARL HERING

Honorary Member American Electrochemical Society

bon Co., W. M. Corse of the National Research Council, Washington, and William Blum of the Bureau of Standards. The new treasurer is F. A. Lidbury of Niagara Falls and the secretary is Colin G. Fink of 101 Park Ave., New York City.

#### ORGANIZATION OF THE DIVISIONS OF ELECTROTHERMICS AND OF ELECTRODEPOSITION

At a meeting of the Electrodeposition Division plans were made for future meetings, members of the Council were selected and the following executives were inducted into office: Chairman, Bradley Stoughton, 10 East 44th St., New York; vice-chairman, John A. Mathews, Crucible Steel Co.; secretary-treasurer, Colin G. Fink, New York. Directors: George K. Elliott of Cincinnati, James H. Parker, Wyomissing, Pa., W. J. Priestley of West Virginia, and Dorsey A. Lyon of the Bureau of Mines.

The Electrodeposition Division elected the following officers: Chairman, George B. Hogaboom, 557 Stanley St., New Britain, Conn.; vice-chairman, Charles S. Witherell of New York; secretary-treasurer, William Blum, Bureau of Standards. Directors: Lawrence Addicks, New York; E. F. Kern, New York; F. C. Mathers, Bloomington, Ind., and O. P. Watts, Madison, Wis. Foreign representatives: W. E. Hughes of London and Bertram Wood, Melbourne, Australia.

#### ENTERTAINMENTS AND EXCURSIONS

The local committee was very lavish with its entertainments and Messrs. Boynton, Rouse, Stone, Moore, Tillman, Boyles, Meade and others spared no effort in making the visit of the electrochemists a most enjoyable one. The weather man, too, smiled his best and accordingly the boat trip, the auto tours and the golfing were enthusiastically attended.

Thursday evening at Johns Hopkins University Prof. R. W. Wood delivered a most fascinating lecture on "Fluorescence," illustrating his remarks with many original experiments. Particularly interesting were the reproductions of tests made during the war in detecting secret messages in passports, etc. The nickel glass developed by Prof. Wood which will permit ultraviolet rays to pass through but not the visible was demonstrated and its value to convoys during the war pointed out.

Friday evening the members were the guests of the Engineers' Club of Baltimore. Prof. Roscoe R. Hyde introduced his troupe of trained red-eyed flies and guinea pigs and divulged to mere electrochemists the secrets and eccentricities of the Mendelian law. Of somewhat lighter texture was the spiel by Monsieur Cheval on "Rope as a Byproduct of the Yeast Industry." The whole trick lies in training the yeast bugs to multiply by addition instead of by division. Dr. Northrup introduced his famous "sneeze," Dr. Hering, assisted by "Lid," entertained the members with a selection of historical Section Q songs, and the climax of the "show" was the award of the Pickles Medal to H. C. Parmelee, master of the *Weekly Dope Sheet*.

Friday afternoon the committee had arranged for a glorious boat trip on the steamer Latrobe. It was an exceptional opportunity for "getting together" and making new friends. The weather was ideal and everybody was in the very best of spirits. Two stops were made on the way—the first at the United States Industrial Alcohol plant, the largest of its kind in the world.



DR. CARL G. SCHLUEDERBERG  
President American Electrochemical Society

The storage capacity totals 18,000,000 gal. of molasses delivered at the plant in tank steamers. The daily production of alcohol amounts to 50,000 gal. of 96 per cent. As a byproduct, 3,000 lb. of carbonic acid is shipped per day. Formerly all of this gas was wasted. The fermentation tanks have a capacity of 138,500 gal. each.

The second stop of the Latrobe was at the plant of the Davison Chemical Co. Here the center of attraction was Dr. Patrick's silica gel. A number of very instructive demonstrations were made showing the wide commercial possibilities of the gel. Among the demonstrations was the manufacture of ice by the vacuum process, the drying of air for iron furnaces and the refining of oils.

For Thursday, trips had also been arranged for to many of the neighboring industrial plants—copper, oil refractories, glass and drugs. And, of course, there was golf. The Maryland Country Club is undoubtedly one of the very finest in the country.

#### LADIES' ENTERTAINMENT

Mrs. Richard K. Meade, as chairman, with her staff of loyal helpers, gave the visiting ladies an exceptionally enjoyable time. Perfect weather contributed to the delight of an automobile trip through the Green Spring Valley, after which the ladies inspected Dr. Emerson's model dairy farm, where refreshments were served. After a lively card party at the Baltimore Country Club, the ladies were keenly interested to get a peek at Lord and Lady Astor, who were likewise being entertained at the club. Dancing at the Engineers' Club was enjoyed Thursday night, and a bounteous spread at the Hender ice cream plant on Friday morning. A climax was reached Friday night, when at least forty ladies attended Fred Stone's inimitable play "Tip Top."



## A Discussion of the Slip Interference Theory of Hardening

**Hardness Caused by Dispersed Particles Is Due to a Dislocation in the Spacing of Surrounding Atoms Rather Than to Intrinsic Hardness of Particles Themselves—Maximum Hardness Does Not Involve Minimum Ductility—Extreme Cold-Work Actually Causes a Slight Softening**

BY PAUL D. MERICA

Research Department, International Nickel Co.

**T**HE mechanism of the hardening of metals and alloys by cold-working has been much debated. I believe that the earlier of the two theories held widely at present was developed by Tammann and Heyn. They consider that as a metal is deformed cold—viz., below its equicohesive temperature range—it suffers internal slip along cleavage planes within each grain, first along those most favorably inclined to the direction of the applied stress, and subsequently and progressively along those planes less and less favorably inclined to this stress. As the deformation is progressively transferred to slip planes requiring applied stress, in consequence of their greater inclination to it, the metal is thus progressively hardened and its ductility exhausted by continued cold-working. Inasmuch as the adjacent grains have in general different orientations, the slipping cannot proceed in a parallel direction across them; each grain thus interferes with movement along the slip planes of its neighbor. Since this increases the resistance to slip, it increases the measured hardness of any such aggregate of grains.

However, the adherents of the so-called amorphous metal hypothesis, Beilby, Desch, Rosenhain and others, declare that the above explanation is not sufficient. They say that the increased hardness obtained by cold-working a metal is in part also due to the generation of a layer of relatively hard and viscous amorphous cement-metal along each plane at which slip has occurred, which amorphous metal acts to rigidify this plane and prevent further slip.

### LIMITATIONS OF FORMER THEORIES

Neither of these theories attempts to explain the natural hardening of metals—i.e., that by alteration in the chemical composition of alloys and obtaining in the fully annealed state. That is, however, the purpose of Messrs. Jeffries and Archer's hypothesis on the hardening of metals by slip interference.<sup>1</sup> Following more closely the former than the latter theory, they have taken a definite forward step and affirm that interference with slip along these cleavage planes within a grain may also be caused by the presence there of a second phase of any material either in atomic or in colloidal dispersion, these particles acting in a sense as keys. The increased hardness of solid solutions is thus explained by them. Furthermore, the hardness observed in steel, particularly manganese and high-alloy steels and in duralumin, seems to be imparted to a maximum degree when the hardening particles, cementite and CuAl, respectively, are present not in

atomic dispersion but in molecular groups of perhaps colloidal size. They point out that the effectiveness of a certain per cent by volume of a keying material must in general increase as its degree of dispersion and fineness increases and are obliged to assume, in order to account for the phenomena observed in duralumin and steel, that this effectiveness, however, again diminishes when the particle has become so small as to lose its crystalline character. For this they give no explanation.

This theory has the advantage of presenting a readily visualized picture of the mechanism of hardening by dispersed particles within a metallic grain. It also agrees well with our experience in the effect of fineness of structure on hardness and strength. I believe that there can be no doubt that hardness in such cases is caused by the interference to slip caused by these particles and that in general this effect must increase with increased dispersion of a given volume of the particle material.

Messrs. Jeffries and Archer are inclined to think that the hardening action of dispersed particles when present in relatively small amount—from 1 to 10 per cent by volume—cannot be due to any added factor of cohesion introduced by the presence of the particles, but that these particles act merely to develop in a better manner the latent cohesion of the original metallic grain. They believe that this cohesion is entirely sufficient in all cases to account for the increased hardening observed. With this statement I cannot fully agree, although the modification of it which I should like to suggest is, I think, not fundamentally different from the sense of Jeffries and Archer in their development of this theory. My thought is that the added resistance to slip produced by the presence within the slip plane of a key particle is not literally due to the necessity of shearing this colloidal particle during the act of slip, but that from its presence there result additional atomic forces, chemical in nature, acting between this particle and the surrounding layers of atoms of the solvent grain.

### NUMBER OF KEYS REQUIRED TO LOCK EACH PLANE ONCE

That a strictly literal interpretation of the keying action is not desirable should be evident from the following considerations: In a round grain of metal (considered henceforth only in two dimensions for the sake of a simplification, which does not affect the results of the reasoning) of diameter  $D$  we may suppose that there are two systems of potential slip planes at right angles to each other, the individual planes being separated by a distance of  $10^{-7}$  cm. It may readily be seen in Fig. 1 that all of these planes can be keyed by a double row of circular particles situated along a diametral line at 45 deg. to the planes; with particles to be

<sup>\*</sup>Presented at a meeting of the Institute of Metals Division, American Institute of Mining and Metallurgical Engineers, Feb. 20, 1922.

<sup>1</sup>"The Slip Interference Theory of the Hardening of Metals," by Zay Jeffries and R. S. Archer, *CHEM. & MET. ENG.*, June 15, 1921, vol. 24, p. 1057.

contiguous with one row staggered with respect to the other by half the diameter of the particle  $d$ . Furthermore this same number,  $n$ , of particles necessary to accomplish this could be arranged in practically uniform distribution within the grain in such a manner as still to key perfectly every slip plane once. We can regard this number of key particles, therefore, as the minimum necessary to key all slip planes and at the same time be present in uniform distribution. If  $p$  is the volume per cent (or, as we are taking it, area per cent) of the key particle material we have the following relations:

$$\frac{1}{4}nd = D \text{ and } \frac{\pi}{4}nd^2 = \frac{\pi}{4}D^2p$$

Let  $k$  be the number of times each slip plane is keyed. Consideration shows that  $k$  is identical with the ratio of half the length of the string of key particles to the diameter of the grain. Therefore  $k = \frac{nd}{2D} = \frac{Dp}{2d}$

Now the force necessary to shear through all key particles on each slip plane, taking  $s$  equal to the unit shearing stress of the key material, is equal to  $sdk = \frac{1}{2}sDp$ , and is hence independent of the number of key particles on each plane and hence within the grain. This is not a reasonable conclusion if we require that the resistance to slip increase with the degree of dispersion, since it is not indicated.

Further, the order of magnitude of the particle necessary to properly key all slip planes is not convincing. Take the example of duralumin: In a grain 0.1 mm. diameter containing 5 per cent by volume of CuAl<sub>3</sub>, all slip planes on any cross-section would be perfectly keyed as soon as the number of particles had increased to 800 with average diameter of 0.0025 mm., and on the above assumption further increase in dispersion would not involve any further increase in slip resistance. On this basis the particle size causing maximum hardness would also depend on the size of the aluminum grain, which does not seem reasonable.

#### ATOMIC FORCES ALSO REQUIRED

I have preferred to ascribe the slip interference to atomic forces acting at the surface of the key particle and through one or more atomic layers of the surrounding matrix. Thus one can regard the particle as in a sense adsorbing the surrounding medium or solvent and surrounding itself with a film whose properties are markedly different than in the undisturbed atomic matrix of metal. In fact we must assume that within this film the cohesion is greater than without it and that it is to this added cohesion that the interference and consequent additional hardness is due. When you thus admit the strengthening of surrounding metal by means of surface film action, it is readily seen that with a small enough particle the whole mass of the grain could be so strengthened.

Thus, if  $m$  be the thickness of the film of metallic solvent adsorbed by the hardening particle, the volume of the grain so affected or adsorbed and strengthened is equal to

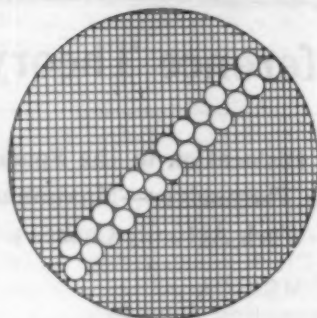


FIG. 1—DISTRIBUTION OF KEY PARTICLES TO KEY EACH SLIP PLANE ONCE

$$V = \frac{n\pi}{6}(d + 2m)^3$$

and

$$n = \frac{D^3}{d^3}p$$

From these expressions the ratio of this volume  $V$  to that of the grain is

$$k = p\left(1 + \frac{2m}{d}\right)^3$$

When the whole volume of the grain has been so adsorbed by the key particles and strengthened by their presence,  $k = 1$  and

$$\frac{1}{p} = \left(1 + \frac{2m}{d}\right)^3$$

This requires that the particles of CuAl<sub>3</sub> to give maximum hardness in duralumin, following this condition, have an average diameter of about  $10^{-5}$  cm., or 100 molecules, if we assume that the surface film of aluminum atoms adsorbed by each particle is  $10^{-5}$  cm. in thickness. This seems a reasonable value and agrees well with that estimated by the authors.

I believe that this conception is not outside of or contrary to the sense of Jeffries and Archer's theory, although in one particular it differs from it in that it requires an actual strengthening effect exerted by each particle—either atom, or molecule, or group of molecules—on the atom layers of solvent immediately surrounding it and outside of its own limited volume. That we must grant that there is added cohesion in the case of at least some solid solutions I think we shall be obliged to admit after a consideration of the work which Mr. Bain<sup>1</sup> has been doing on the atomic structure of such solutions. Thus he finds that a copper lattice takes up zinc atoms to form high brass without alteration of the lattice, the zinc atoms merely substituting identically for the copper atoms. Now, since the lattice is not altered, we can scarcely in this case speak of a key action in a literal sense; nevertheless the hardness of the solid solution is greatly increased. In my opinion we are obliged to assume a different summation of atomic cohesions when the zinc atoms are in place than when they are not.

#### ADSORBED ATOMS INVOLVE FORMATION OF MOLECULES

I am inclined to think that one cannot speak of an atom adsorbing surrounding atoms in the form of a film except in the sense that a new molecule is formed. Therefore the picture I have drawn above of the strengthening effect of small particles as due to the films of solvent metal formed around them must be considered as limited to molecules or groups of molecules. When the molecule is actually disintegrated into atoms and goes into atomic dispersion in true solid solution, this precise effect disappears and the resulting properties are due rather to the cohesion conferred simply by the atomic arrangement of the new atoms. It is conceivable that this cohesion may be much less than that due to molecule-groups with adsorbed solvent.

Thus it would seem that this slightly modified conception of the hardening theory is more elastic in that it more readily permits of an explanation of the less pronounced hardening effect of atoms of copper on aluminum than of molecule-groups of CuAl<sub>3</sub>, and indicates that the reason for the apparent anomaly is in the

<sup>1</sup>"Crystal Structure of Solid Solutions," by Edgar C. Bain, read before the February, 1922, meeting of the American Institute of Mining and Metallurgical Engineers. Abstracted in CHEM. & MET. ENG., vol. 26, No. 14, p. 655, April 5, 1922.



nature of the field of force surrounding copper atoms and that surrounding the molecule or molecule-group of the compound. I may say that I am rather inclined to agree with Jeffries and Archer in their contention that in true solid solutions, both duralumin and austenitic steel, the copper and the carbon respectively are present in atomic dispersion.

#### MAXIMUM HARDNESS DOES NOT NECESSARILY INVOLVE MINIMUM DUCTILITY

Another conclusion is drawn by Jeffries and Archer which does not seem to be quite in accordance with the facts, nor does it seem to be a necessary consequence of their theory. That is that maximum hardness is accompanied by minimum ductility. Now this is indisputably true in general, but I believe that there are exceptions to the rule. Of course we may dispute about the method of properly measuring ductility, and I for one must confess myself at a loss as to how that interesting property may be precisely measured. But accepting the current methods of its measurement, it is a fact that the hardening of duralumin during aging after quenching is often accompanied by an increase of ductility (as measured in the tensile test), particularly when the aging is carried out at lower temperatures. Furthermore, I recall some data presented some years ago by W. R. Webster<sup>1</sup> showing that the tensile test ductility of common high brass, a solid solution of zinc in copper, is greater than that of copper and of course it is also harder and stronger. In fact, it was striking to note that an addition of zinc to copper raised simultaneously the tensile strength and the ductility. Information from some of the brass manufacturers would be interesting as to whether high brass is actually more malleable and ductile in manufacture than copper. Looking at the matter from the standpoint of the slip interference theory, if the hardening is due merely to increased atomic force or bond on each potential slip plane, the slip planes remaining identically the same, there seems to be no reason for assuming anything in particular about how the ductility is affected by key particles. If anything is to be deduced, the conclusion would be that ductility is unchanged rather than that it is diminished.

I have for some time believed that our knowledge of hardness, both in practical and in theoretical respects, would be greatly improved if instead of measuring merely the hardness at one value of the plastic deformation, such as we do in the current methods, we should measure also the rate at which this hardness increases with deformation; we should determine in fact the "deformation rate of increase of hardness." For example, a comparison of this rate for aluminum and for quenched and for tempered duralumin would indicate whether the effect of the dispersed particles of copper or of CuAl<sub>3</sub> was merely to increase the force necessary to produce slip on each plane or whether they actually altered the mode of deformation. If the former, the ratio of the rate of hardening of any one of the materials to that of the other should be the same as that of any particular value of the hardness taken under corresponding conditions, whereas if the actual mode of deformation is altered by the presence of the copper there might not be such correspondence.

#### SOFTENING BY EXTREME COLD-WORK

The course of the hardness-deformation curve is

<sup>1</sup>Proc., Int. Soc. Testing Materials, 1912, vol. 7, p. 6.

known for many metals and alloys in the initially annealed state and it seems to be of the same general form for all which have been studied. And this is true whether we consider the stress-strain curve in a tensile test or the hardness of sheet after cold-rolling to greater and greater reductions. The unit force or stress required per unit of deformation (plastic or permanent deformation only is of course here considered) increases with progressive deformation, but at a progressively decreasing rate; finally—at least for copper and copper-nickel alloys—the rate passes zero and actually decreases. The cold-worked metal becomes softer. The latter phenomenon occurs in Monel metal, for example, after about 95 per cent reduction by cold-rolling.

Now this is certainly not what we might expect from a literal application of the theory of Tammann and Heyn. For in general the tensile stress required to produce slip on planes making an angle,  $\theta$ , with the normal to the axis of the tensile stress is equal to  $s \div \sin \theta \cos \theta$  when  $s$  is the shearing stress required to produce slip.

Now this stress is least when slip is occurring on the 45 deg. planes and is equal to  $2s$ , and it increases as the planes are affected, making a greater or a lesser angle, but its rate of increase is continually increasing, not decreasing, and it finally becomes infinite when the angle is either 0 or 90 deg. This conclusion does not fit the facts.

It is of course obvious that although an application of tensile stress equal to twice the shearing stress required to produce slip on each unit slip plane should produce slip on the 45 deg. planes of an aggregate of metallic grains, it cannot in general do so owing to the interference of grains whose slip planes do not lie in this particular direction. The stress required to start slip depends therefore on the arrangement of all of the grains composing the specimen and represents a statistical summation or average of the individual stresses required for each grain with its different orientation. Its application not only produces slip along some favorably inclined planes but along some which are less and even least favorably inclined and it serves probably also to rotate some grains bodily which could not otherwise take part in the deformation.

We may consider then that each increment of applied load has to overcome the resistance of a certain combination of internal stresses, defined by the orientation and the size of the component grains, the total resistance amounting to the summation or integration over all of the infinitely small increments of resistance. What is the nature of these combinations? Whatever it may be, I think we may feel confident that there are combinations of varying probability of existence; thus one with all slip planes of all grains inclined at 45 deg. to the direction of the applied tensile stress is highly improbable, whereas one with all possible orientations and shapes of grain is the most probable. Now, although I am not in position to give this statement a rigid proof, it seems reasonable to assume since there is no type of unit grain resistance that is infinite (i.e., if a grain is so oriented that no internal slip is possible, the whole grain may be rotated by external pressure into a position in which this is possible), that the most probable combination of grains is

<sup>2</sup>See "Mixed Orientation Developed in Crystals of Ductile Metals by Plastic Deformation," by Edgar C. Bain and Zay Jeffries, CHEM. & MET. ENG., vol. 25, p. 775, Oct. 26, 1921.

characterized by the maximum integrated resistance to deformation. At least we can readily see that some, even many, other combinations, less probable, will have what may be seen as a minimum resistance.

If this be assumed to be true, we may derive the well-known form of the stress-deformation curve, since the number of combinations present of any arrangement is of course proportional to the probability of the arrangement. Therefore there are relatively few arrangements present giving a low initial stress necessary to start slip, but as we increase the load to that characteristic of the most probable arrangement (assumed to require the maximum load to produce deformation) the number of arrangements or combinations present increases and in consequence the increment of deformation also increases, since each combination contributes a certain amount to the total deformation. The form of the stress-deformation curve should therefore be the same as that of one side of the probability integral, which indeed it is.

Now this is, of course, but a first approximation to the truth and is only perhaps valuable as a picture illustrating the statistical nature of deformation in metal grain aggregates. It neglects, for example, the plain fact that the very act of deformation alters the existing combinations for the next stage. But the explanation must lie in the latter fact that finally the metal becomes softer, the resistance of the combinations less to continued deformation. We must assume, I think, that finally the most formidable obstacles to ready slip are permanently removed by rotation, and the great amount of deformation already suffered has served to impart direction to the grains themselves, consequently increasing the number of less probable, less resistant combinations.

An interesting fact should be noted as a theoretical consequence of a statistical theory of deformation—namely, that the smaller the grain size (or more properly the smaller the ratio of grain size to size of test specimen) the greater should be the consistency of agreement between tests of the same material but different specimens. With test specimens involving few grains there should be quite marked variation noticeable, particularly in the yield point.

I believe that if we could by a sufficient study of the mechanical properties of single grains lay down the fundamental principles of grain slip and define the forces requisite to produce it, it would become possible to apply these principles by means of the statistical methods used successfully for gases to the consideration of the mechanical behavior of grain aggregates, and I have no doubt that this will one day be done. In that day metallography can properly lay claim to be as accurate a science as mechanics itself!

#### Cadmium Electroplating

The udyrite process of cadmium electroplating covered by United States patents 1,383,174, 1,383,175 and 1,383,176, with other patents pending, embodies electroplating with the metal and subsequent heating in an oven for several hours at 150 to 200 deg. C., by which the cadmium coating is alloyed with the metal of the article coated. Late in 1921 this process was installed in eighteen plants and contracts were made for installations in nine more plants. This process has been applied to rustproofing locks, hardware, kitchen-cabinet and refrigerator trimmings and automobile parts.

#### New Customs Service Sugar Laboratory

The Bureau of Standards has been of assistance to the Customs Service of the Treasury Department in connection with the installation of the new laboratories for sugar analysis at Baltimore. This work, which is now practically completed, has included the installation of a chemical laboratory equipped with model benches with alberene tops, hoods and the necessary accessory equipment. A polarimetric laboratory has likewise been designed for the analysis of imported sugars.

Owing to the fact that the building which had to be utilized for this sugar laboratory was not equipped with all the appliances needed, it has been necessary to plan for the installation of a steam boiler, hot water heater, vacuum and compressed air outfit, as well as the necessary gas and electrical connections essential for work of this kind. By detailing a member of the staff of the bureau to Baltimore and through the loan of apparatus, it has been possible to carry out sugar testing at Baltimore even before the completion of the new laboratory. So far tests on the exchange samples of sugar for comparative purposes show satisfactory agreement between this and other laboratories of the Customs Service.

#### Tests of Various Types of Extinguishers for Zinc Dust Fires

Tests have recently been made by the Bureau of Mines on the effectiveness of water, sodium carbonate solution, carbon tetrachloride, silicon tetrachloride and a frothy mixture as extinguishers for zinc-dust fires. The frothy mixture extinguished the fire most quietly and effectively, so it was tested on a larger fire in 300 lb. of zinc dust. Three 2½-gal. foam extinguishers smothered the fire, but danger of rekindling had passed only after lapse of several hours, due to retention of heat in the metal by the non-conducting foam blanket.

Thermal data show that water, carbon tetrachloride and carbon dioxide react with zinc with liberation of considerable heat, carbon tetrachloride producing most. However, no violent reaction occurred when red hot molten zinc was poured into carbon tetrachloride.

Although some fire extinguishing materials may be injurious or may be decomposed in fires to produce toxic gases or vapors, no especially poisonous gases or fumes are evolved from burning zinc itself or from the action of extinguisher material on the zinc.

#### To Investigate Paper Pulp Sources of Australia

According to a report which appeared recently in the *Industrial Australian and Mining Standard*, the West Australian Forests Products Laboratory and the Commonwealth Institute of Science and Industry have been authorized to carry on experiments on a semi-commercial scale, with a view to ascertaining whether it is possible to produce paper pulp from Australian timber. The federal government is to spend £2,490 a year in salaries and provide equipment for carrying on the investigations. In addition, the institute will spend a special appropriation in carrying out experiments. The Western Australian Government contributed £1,900 and certain newspapers £600, while other states have contributed £1,300. There was a private contribution of £100 from a Victorian paper manufacturing company. The Western Australian Government has offered £5,000 conditionally upon the Commonwealth Government finding a similar amount for the purpose of building a laboratory in Western Australia.



## Handling the Finished Products of Industry—II

Preparing Yeast for the Market at the Plant of the Fleischmann Co. in New York City—  
Automatic Equipment Used for This Work—Principles of Handling  
Illustrated by This Installation\*

BY GRAHAM L. MONTGOMERY

THE FLEISCHMANN CO. has in New York City a plant in which yeast is compressed and wrapped in the various packages that are offered for sale. As yeast is used in baking and enters in other ways into food, it is necessary that the yeast and the plant in which it is handled be maintained in as absolute a state of cleanliness as it is possible to reach. In order to achieve this end in the best way it is necessary to use automatic machinery. The machinery originally installed was for mixing the yeast with water, compressing and forming it, cutting it into cakes of the desired sizes and wrapping and labeling these cakes. Conveyors have recently been installed to handle the yeast used in making the 1-lb. cakes which are supplied to bakers. This has worked a noteworthy improvement in this department.

The yeast is received from the manufacturing plant in Peekskill, N. Y., in a dry state, packed in paper cartons 14 x 15 x 11 in. and weighing 50 lb. each. Shipment is made by rail, motor truck and barge, the greater part coming by barge and being transferred at the pier from the barge to motor trucks which transport it the short distance to the plant.

### HANDLING BULK YEAST AT THE PLANT

The yeast cartons are unloaded by hand from the motor trucks and then placed on a straight steel slide which leads from a hatchway in the sidewalk outside the building to a gravity roller conveyor in a basement storeroom as shown in the accompanying illustration. This conveyor runs across the upper part of this storeroom. It is hinged at one place so that an 8-ft. section may be raised to permit a clear trucking aisle. This gravity roller conveyor is of standard design, having ball-bearing steel tube rollers 1.9 in. in diameter, 16 in. long and spaced 4 in. on centers. The bed, rails and supports are of angle iron.

The cartons of yeast pass on this conveyor across the storeroom into the cold room. The conveyor enters and leaves the cold room through insulated refrigerator doors, which are kept closed when the conveyor is not in use, making it easier to maintain the required temperature of 22 to 24 deg. F. in this room. When yeast arrives at the plant faster than it can be used, it is unloaded by hand in this cold room and stored to await the time when it is needed in the packing room.

From the cold room the cartons pass out into the main basement of the packing building. The gravity conveyor leads by one 90-deg. bend directly to the intake of the vertical package elevator shown on the accompanying illustration. This elevator takes the cartons automatically from the gravity conveyor, one at a time, and raises them to the first floor, depositing

them on another gravity roller conveyor. The construction of a vertical package elevator makes it necessary for the packages to be carried over the top of the elevator and lowered on the other side somewhat below the lowest part of the two head sprockets before a discharge can be made. This is due to the automatic discharging arrangement, which is made up of steel fingers. These fingers, stationary in location at the point at which it is desired to make the discharge, come opposite the spaces between the bars which make up the pivoted tray on which the carton or package is carried. As the tray is lowered it will be seen that the fingers of the discharger remove the package. It then slides down a short incline to be taken up by whatever means is there provided.

There is an advantage inherent in the fact that the elevator must deliver on the opposite side from that on which it receives its load in that it occasions no reversal of the direction of progress of the package through the conveying system and the resulting installation is cheaper and requires less space. In this particular case it is necessary to start the yeast in the packing process at a point near the ceiling of the room. For this reason it has been necessary to include in the system this additional elevating unit.

The short length of gravity roller conveyor at the outlet of the package elevator conveys the cartons to an inclined slat conveyor which elevates them to a sufficient height for the operations which the yeast is to undergo in the packing process. This will be seen by reference to the illustration. This inclined slat conveyor is 14 in. wide and 14 ft. on centers and is made up of roller chain and steel slats, the chain traveling in the guides provided in the frame for that purpose. The drive of this conveyor is by means of an electric motor mounted on the frame. This conveyor and the gravity conveyors at either end of it are suspended from the ceiling.

The cartons are discharged from this slat conveyor onto a gravity roller conveyor 12 ft. in length which conveys them around a 90-deg. bend and deposits them on the breaking table. Both the gravity conveyors on the first floor are the same in specification as that in the basement. When the carton reaches this point the yeast has completed the movements coming under class 1 handling as defined in the first paper of this series. Here it enters the forming and wrapping processes which come under class 3, as defined in that paper.

### PREPARATION OF THE YEAST FOR THE WRAPPING MACHINES

At the breaking table the yeast meets with the first manual handling since it was unloaded from the truck in the street, except in cases where it has been held

\*Part I of this series was published in *Chem. & Met. Eng.*, vol. 26, No. 18, p. 823, May 3, 1922.

for storage in the cold room, in which case it had to be taken off the conveyor and put back on it by hand. Here it is dumped from the cartons against a steel plow situated in the middle of the entrance to a steel slide. As it strikes this plow it is broken up into smaller pieces. The steel slide takes these pieces down a short distance into the mixer. This mixer is a standard type of Werner & Pfleiderer dumping mixer of sufficient capacity to mix 200 lb. of yeast per minute. The yeast has reached this mixer in a dry and crumbly state. Here a certain amount of water is added and thoroughly mixed through the mass until it reaches the proper consistency for compressing.

As soon as this mixing is completed, the yeast is dumped into the long trough marked on the accompanying drawing. There is not sufficient water in the yeast to cause it to flow readily and a worker stands here with a shovel and distributes the yeast in the trough to the four spouts which feed the four compressing machines. The yeast passes through these four spouts into hoppers which form part of the compressing machines. Under each hopper is a small screw conveyor which picks up the yeast and forces it into the compressing machine. From this it is extruded through a die in the form of an endless square bar with the exact cross-section required in the finished 1-lb. cake.

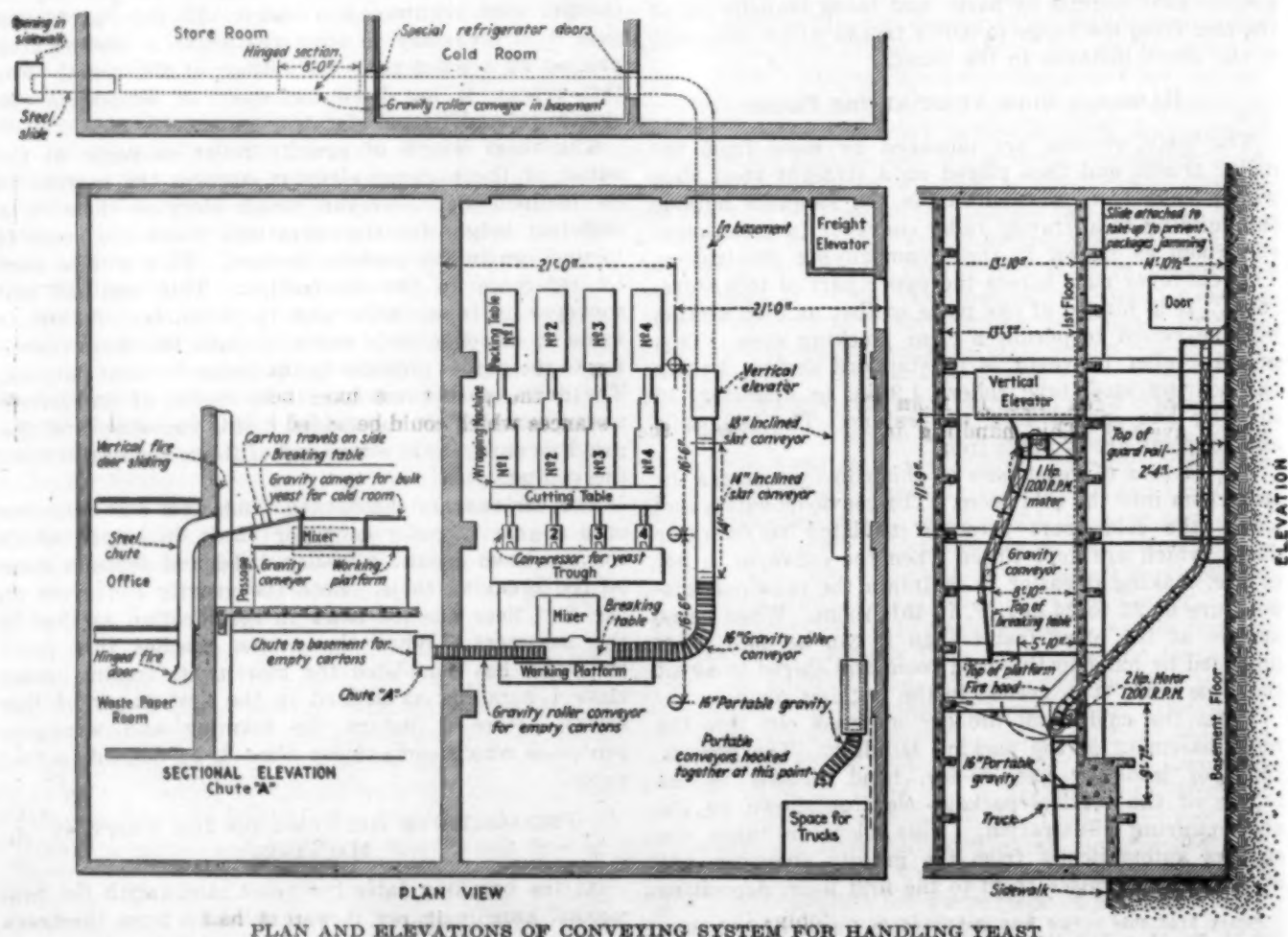
As the endless bar of yeast is extruded it passes onto a small flat belt conveyor, the forward motion of which is exactly timed with the rate of extrusion. This belt conveys the bar under the cut-off—at present operated by hand, but which without doubt will before long be mechanically operated. This cut-off is a tightly

stretched wire mounted in a swinging frame with its plane of motion at right angles to the motion of the bar of yeast. When a measured length of yeast sufficient to weigh 1 lb. has passed under the cut-off it is operated and in this way uniform pieces of an exact pound in weight are obtained. The operator piles these on the table which is shown in the drawing as situated at the inlet end of the wrapping machine. Random samples are weighed on a scale mounted here in order to keep a running check on the operation.

#### WRAPPING 1-LB. CAKES OF YEAST

The operator situated at the head end of the wrapping machine takes the cakes of yeast—both those from the pile on the table and those from the scale—and places them on the flat, feeding belt conveyor which forms the first part of the wrapping machine. They are put on this belt with their long dimension perpendicular to the axis of motion of the belt. This belt carries the cakes into the machine where each is wrapped and sealed in a transparent sheet of paraffined paper on which an appropriate label is printed. The wrapped cakes are then discharged from the machine onto a second flat belt, which conveys them to the packing tables. Here they are packed by hand in cartons for shipment. These cartons are placed, when filled and sealed with paper tape, on hand trucks and wheeled to the desired point for storage or shipment.

The wrapping machines, designed and patented by the Fleischmann Co., are extremely ingenious. They are simple in operation and have by far less parts than most machines which are built for this class of



PLAN AND ELEVATIONS OF CONVEYING SYSTEM FOR HANDLING YEAST



work. The capacity of each machine is fifty wrapped and sealed 1-lb. cakes per minute. The four machines installed in this plant thus have a total capacity in 1-lb. cakes of 48 tons for each 8-hour day.

#### GETTING RID OF THE EMPTY BULK YEAST CARTONS

The cartons from which the bulk yeast has been removed are placed by the workman at the breaking table on the empty carton conveyor. This is a gravity roller conveyor of the "sensitive" type. It is made up of 1½-in. diameter rollers spaced 2 in. on centers and 18 in. long. The rollers are carried by means of ball bearings on through shafts, these shafts being fastened in the angle iron frame of the conveyor.

The cartons are carried by this conveyor to the adjacent wall, where they pass into the 18 x 18-in. straight steel chute shown in section-elevation "A" on the accompanying drawing. This chute, provided with safety fire doors, held open by fusible links at its intake and outlet, takes the empties to the basement and discharges them on a receiving table. Here a workman collapses them and ties them in bundles for shipment back to the plant in Peekskill.

#### HOW THE PRODUCT IS HANDLED IN SHIPPING

As shown above, the wrapped cakes are packed in cartons directly adjacent to the wrapping machines and thus no handling is necessary there. All of these cartons which are for immediate shipment are wheeled directly to the shipping platform on the trucks on which they are placed when packed. This is possible because all these operations occur on the first floor of the building. Those which are to be placed in storage for future distribution are taken to the basement by freight elevator and placed in storage in the room in which the foot of the vertical package elevator is situated.

To take these packages from storage to the shipping platform an inclined slat conveyor 18 in. wide and 43 ft. on centers is provided. This conveyor starts with a horizontal run of about 20 ft. along the wall of the room in which the cartons are stored. This permits the loading of the conveyor through the entire length of this run. At the end of this straight run the slat conveyor raises the packages up through a hatch in the floor to a point somewhat above the level of the shipping platform. Here they are loaded into motor trucks for distribution by means of a length of portable gravity conveyor fed directly from the discharge of the slat conveyor. This handling in connection with the shipping is of the second class described in the first paper of this series.

#### EQUIPMENT USED IN THIS INSTALLATION

The gravity roller conveyors used in this installation are all of standard design and size. The inclined slat conveyors are standard design, but these must always be built for the particular distance on centers and rise which the job requires. The vertical package elevator is a standard machine. The chutes, as with all chutes, are built to fit the job. All this equipment is painted with either aluminum paint or white enamel. This serves the purposes of cleanliness and also conforms well with the surroundings, for the rooms are finished in white enamel and white glazed tiles.

All the conveyors described above were furnished by the Dow Co., Louisville, Ky., except the vertical package elevator, which was furnished by the Robins Conveying Belt Co., New York City.

The decisive reason which makes the use of mechanical handling equipment and automatic machinery advisable in the installation just described is the fact that the product—a food product—must be kept scrupulously clean. While it may be possible with hand methods, it requires extreme care and much oversight to accomplish this end. The use of this equipment provides a much cheaper, quicker and less burdensome way of obtaining the desired result.

The combination of conveying equipment and automatic machinery here described has incidentally effected several other advantageous results for the plant. First, it has eliminated all possibility of confusion in the transportation of the yeast by preventing any crossings in the flow of material through the plant. Second, it has eliminated a number of workers who would otherwise have been employed and has thus made the work more economical. Third, it has lessened the burden of management in the plant because it is nearly automatic in operation. Fourth, by producing more completed packages in the same space, it has lessened the overhead of the operations. And fifth, because the cleanliness necessary has made a showplace of the plant, it has a distinct advertising value.

The writer wishes to acknowledge his indebtedness to L. L. Tieman, constructing engineer of the Fleischmann Co., and to H. Dunning of the Dow Co. for courtesies and drawings furnished.

#### Desulphurization of Cast Iron

It is commonly known that there are three practicable methods of reducing the amount or the effect of sulphur left in the pig iron coming from a blast furnace. In the first place, if sufficient manganese is present to form MnS with all the sulphur, this inclusion is not nearly so damaging as FeS existing in low-manganese pig. This expedient is the only one commonly used in the foundry. Secondly, if pig iron be kept molten in a mixer or other large container, MnS will float to the top and the sulphur burn off. Thus there is often a loss of one-third the sulphur between blast furnaces and steel furnaces from this cause, especially in high-manganese pig. Third, advanced foundrymen who have installed basic electric furnaces can produce irons containing as little sulphur as desired by correct refining under a carbide slag.

In the past there have been many rumors of substances which could be added to cupola metal in the ladle and sulphur forthwith vanishes. Many have been tried and found wanting. Speaking informally before one of the recent sessions of the American Electrochemical Society at Baltimore, Dr. Richard Moldenke said that a new physic of this sort (probably a potash compound) had attained a wide vogue in Germany, and he was anxiously awaiting receipt of a quantity of the material so it could be tested on American irons.

The method was said to be: After the hot cupola metal had been tapped into a ladle all the slag was carefully removed, and a small amount of the compound added. This readily alloyed with the iron, causing more or less violent circulation in the metal. In 4 or 5 minutes the currents had quieted down and a very thin slag appeared, which was absorbed by a little lime, and carefully skimmed. Analysis would then show that the metal, originally, say, 0.14 S, retained but 0.07 per cent. It is reported that half of this remainder could be removed by a second application.

## Metallic Sodium—I

### A Critical Review of the Development of the Metallic Sodium Industry—Wide Variety of Processes Based Upon the Electrolysis of a Molten Bath Consisting of or Containing a Sodium Compound Such as Caustic Soda or Salt

By HOWARD E. BATSFORD

IN THE attempt to prevent a duplication of effort in the further development of metallic sodium work, and to provide an easy way for the beginner to get an insight into the practices of those men who labored very diligently in the field of alkali metal production, the author has made a summary of all the available data on this subject, condensing it in such a manner that there is very little repetition, except for comparison.

An attempt has been made to explain or comment on the important parts of each patent, with a view to showing why the particular patent is not now in commercial operation. The greatest fault of the inventor seems to be in trying to make the apparatus complicated, which instantly means greater cost, difficulty in construction, and finally costly operation and replacement of parts. In many cases the patent is not made in accordance with the actual apparatus in question, since the inventor felt compelled to disguise his real secrets so that they are unrecognizable.

Naturally, the largest share of the earlier work was carried out by chemical means, but in the early '90s electricity became more available and men turned to it as to a panacea for all ills. One of the greatest drawbacks to sodium reduction from its salts was the extreme temperature required; the electrolytic cell seemed to solve the temperature problem but introduced other difficulties such as metallic fog, contamination of other materials by selective depositions, and destruction of cell and electrode material. These evils have slowly been eliminated until today there are on the market, or rather available for commercial use, cells for making metallic sodium of high purity from either fused caustic soda or fused salt, at prices which make it profitable to manufacture, provided the market for the finished product is large enough.

#### Electrolytic Production of Metallic Sodium

There had been several attempts to make sodium electrolytically after Davy produced small quantities of it with his voltaic cell, but Matthiessen, following the lead of Bunsen, in 1855 succeeded in making it by electrolyzing a mixture of salt and calcium chloride in the proportions of 2 NaCl to 1 CaCl<sub>2</sub>. This mixture had been dehydrated by heating with ammonium chloride and freed from basic salts.

The troubles encountered by the latter were noticed by Hopfner, who sought to avoid them by using soluble anodes such as copper or silver. These were expected to retard the losses due to solution of chlorine in the melt and the resultant reaction with the sodium, but proved of no avail, since the chlorine gradually passed through the electrolyte and attacked the sodium.

In 1890 Grabau made a cell in which he used bell-shaped compartments for collecting the sodium and chlorine. These were quickly destroyed and were replaced by the formation of solid electrolyte on the walls. His explanation was that the corrosion was due to leakage of current more than to the corrosive action of the electrolyte. The frozen layer was kept in condition by cooling the annular metal walls of the cell.

Grabau made further use of a mixed electrolyte for reducing the melting point of the bath, as Matthiessen and Bunsen had done before him. The bath used was  $3(\text{NaCl}, \text{KCl}) + \text{SrCl}_2$ .

The sodium produced contained about 3 per cent of potassium but no strontium. Barium chloride does not melt so easily, and calcium chloride is so difficult to free from water that he preferred strontium chloride to the two others. The chief causes of failure seem to be the high voltage, frequent clogging of cells and necessity of careful attention.

Grabau figured that at the high temperature necessary for the operation great loss of metal occurred owing to formation of sub-chloride of sodium. This sub-chloride was partly oxidized at the surface of the bath and partly diffused to the anode, where it combined with the chlorine.

#### THE CASTNER PROCESS

In 1892 Hamilton Y. Castner made very important additions to the sodium industry by discovering a process by which metallic sodium could be made commercially from fused caustic soda. Fig. 1 shows the cell as described in U. S. Pat. 452,030; May 12, 1891.

This process consists in electrolyzing caustic soda constantly maintained at not more than 20 deg. above its melting point; also in using a gauze or screen between the electrodes and a superimposed dome for collecting the metal. The temperature must be kept low to prevent re-solution of sodium metal by the bath, and recombination, which takes place actively at higher temperatures.

Caustic soda melts at 308 deg. C. if pure, but down to 300 deg. C. if containing slight impurities.

It is electrolyzed preferably within 10 deg. of its melting point but never above 325 deg. C.

Within 5 deg. of its melting point almost the theoretical quantity of sodium is obtained, at 10 deg. above about 90 per cent, and this is the best obtainable in commercial practice. Above this the yield decreases very rapidly and at 20 deg. above its melting point recombination is as active as decomposition and the bath yields no metal, but lies "dead."

On commencing to pass the current through melted caustic soda, any water present is at first decomposed, evolving hydrogen and oxygen only until every trace of water is gone. After that sodium and hydrogen

NOTE: Complete references to all the work discussed will be found in the chronologically arranged bibliography at the end of the second part of this article.



together appear at the cathode and oxygen at the anode. These must be kept rigorously separated or re-oxidation of the sodium will occur, and the hydrogen will be oxidized, with an explosion.

Borchers made a study of the production of sodium and arrived at the following conclusions in 1894:

For best electrolysis:

1. Alkali metal must be deposited at a metallic (iron) cathode.
2. Cathode space must permit of collection and removal of metal without the latter coming in contact with reducible substances.
3. The anode must be of carbon.
4. The anode space must permit of the easy removal of the halogen, and its walls must be constructed of material capable of withstanding the action of halogens and haloid salts.
5. No metallic particles should be present in the melt between the poles.
6. All the parts of the apparatus must be constructed of fire-resisting material.

In 1902 Janeczke made a special study of the decomposition voltages occurring in the electrolysis of fused caustic soda.

At temperatures corresponding to the melting point of caustic soda, as we have seen before, the sodium is absorbed during electrolysis, as is also oxygen; at slightly higher temperatures these products are absorbed so rapidly that there is no decomposition.

Hydrogen may be formed primarily by deposition at the cathode or secondarily by action through the sodium and water formed at the anode.

Janeczke says that the following reaction takes place:



Therefore, there are present H-ions in small number in the fused anhydrous caustic soda.

The decomposition voltage was found to be about 1.3 v. for caustic soda; below 1.0 v. at the cathode a quite lively generation of hydrogen takes place, the oxygen generation taking place promptly at 1.3 v.

The second decomposition point in the voltage curve is at 2.1 v. At 2.4 v. stream lines seemed to go out from the cathode into the melt with flashes of gas. These were apparently sodium particles which reacted with the caustic soda. From this and other data it was assumed that 2.2 v. represents the point at which metallic sodium is formed.

#### REACTIONS DURING ELECTROLYSIS OF FUSED ALKALIS

LeBlanc and Brode published in the same year (1902) the results of their observations in *Zeitschrift für Elektrochemie* on the electrolysis of fused NaOH and KOH, as follows:

At the anode oxygen and water are formed, this water reacting with the sodium freed at the cathode with the evolution of hydrogen.

Since one equivalent of water exists for two equivalents of sodium, a current yield of 50 per cent is the maximum obtainable in such a process as that patented by Castner. In fact, the yield generally runs around 40 per cent.

At high temperatures sodium dissolves in the melt, causing evidently strongly depolarizing properties in the melt at the anode. The depolarizing effect of the dissolved sodium was so great that only at high current densities could oxygen be formed. Under these conditions the gas formed at the anode was a mixture of equal parts of hydrogen and oxygen, or detonating gas mixed with hydrogen. This throws some light on happenings in the industry.

Sometimes the cell works badly, makes little sodium and almost every minute has an explosion. It is then too hot, the melt is dissolving too much sodium, it depolarizes partly the anode, it partly reacts with the moisture present, and forms rich mixtures of detonating gas which explode.

At a lower temperature, on account of the diminished solubility of the sodium in the melt, the depolarizing effect at the anode and the formation of detonating gas is reduced to a minimum. The Castner apparatus takes the hydrogen and leads it upward inside a wire gauze along with the metallic sodium, neither being permitted to pass across to the anode.

We have here the apparent paradox, that at low temperatures hydrogen is formed at the cathode and at high temperatures it occurs at the anode. Whether the gas evolution is visible or not at the higher temperature depends on the current density.

The anodic gas generation is not, as Castner believed, a result of the increased solubility of oxygen in the melt, but it is a result of the depolarizing action of the dissolved sodium. If the former were true, we would

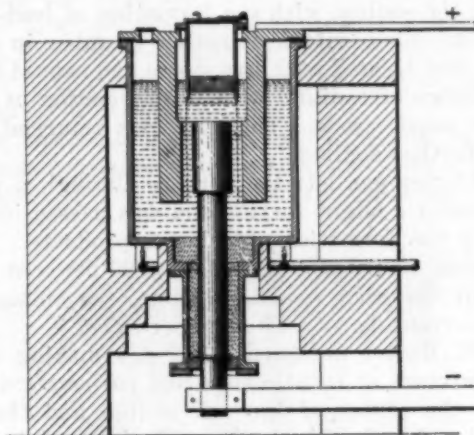


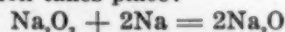
FIG. 1—CASTNER CELL

have anodic hydrogen, but with the latter we have free oxygen and the formation of water.

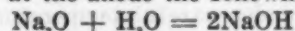
If sodium peroxide is dissolved in the melt, it has the same depolarizing action as the metallic sodium, but at the cathode.

In pure caustic soda melt there is nothing which exerts a depolarizing action at the anode or cathode, and on this account only small currents pass through the electrolyte at low terminal voltages.

There exist at the anode peroxide and at the cathode dissolved sodium, both of which act as depolarizer for the other electrode, and on continued electrolysis, the following reaction takes place:



With water at the anode the following reaction:



A part of the sodium also acts directly on the water. According to which reaction predominates, we have a melt saturated with sodium or sodium peroxide. Luckily we are able to get anodic or cathodic polarization at will, if we allow fresh electrolyte to flow either from anode to cathode or vice versa.

In order to get good yields of sodium, the following precautions are in order:

1. Do not let the water formed at the anode reach the cathode.
2. Get a good diaphragm.

Pure anhydrous caustic contains no H-ions or O-ions but only Na- and OH-ions, and is very hygroscopic.

In a later article by the same authors, nickel was selected as material for anode, since it does not behave as soluble anode. At least, the amount of dissolved nickel in the melt is insignificant in comparison with that which should be dissolved in accordance with Faraday's law. It is very small and easily within experimental error.

In the same year Thomas Ewan electrolyzed fused NaOH in a cell with a diaphragm of sodium aluminate or alumina or a mixture of both. A current of air (or a suitable gas) was passed over or through the electrolyte to remove water.

#### ACKER PROCESS

At the same time Acker patented his process for making caustic soda from fused salt, with the evident desire of finally producing metallic sodium. For this work he used graphite anodes, dipping into a bath of fused salt, which in turn covered the molten lead cathode. The lead, which was circulated through a subterranean chamber in the iron jacket of the furnace, absorbed the sodium with the formation of lead-sodium alloy. This alloy, entering another chamber in its circulation, was treated with live steam and caused to yield up its charge of sodium, with the formation of strong and pure caustic soda. The lead then returned to the cell for further sodium.

The chlorine gas left the furnace through a pipe at the top under a slight suction and was passed into lime liquor for the formation of chlorine products. It contained about 10 per cent chlorine and 90 per cent air.

The current used was 6,000 amp., the voltage 7 v. and the current density 2.9 amp. per sq.cm.

In 1903 Becker designed a cell for making sodium from a mixture of caustic soda and carbonate of soda. He kept the center of the cell molten and the walls frozen, thus keeping the walls perfectly insulated.

In 1904 C. F. Carrier reported some tests made with proportions of  $\text{Na}_2\text{CO}_3$  up to 66 per cent. There was no improvement over the Castner process, and no evolution of  $\text{CO}$ , was detected between 330 and 630 deg. C.

#### USE OF ALTERNATING CURRENT

Hambuechen made a study of the electrolysis of NaOH by alternating current with the following results:

The property of aluminum electrodes, which permit the electricity to pass in one direction only, is made use of for electrolyzing the caustic soda.

NaOH is fused in an aluminum vessel, in which is placed an aluminum electrode surrounded by an iron electrode; a perforated aluminum diaphragm is interposed, insulated from the aluminum electrode by a porcelain sleeve.

Alternating currents of 9 amp. at 4 v. gave a good yield of sodium under careful temperature regulation, with very little corrosion of the aluminum.

#### COST DATA ON CASTNER PROCESS

In 1906 C. F. Carrier published the following figures and facts concerning the Castner process:

##### Advantages:

- Low melting point of bath.
- Simplicity of the apparatus.

##### Disadvantages:

- High cost of raw materials.
- Low ampere efficiency.
- Small size of the units.
- Constant explosions during process.

Ampere efficiency is theoretically 50 per cent, since for every atom of sodium liberated an atom of hydrogen must also be formed.

The metal is removed in dribblets by dipping out with a spoon, so the latter item may be a considerable factor.

#### COST FIGURES (1906)

Daily production.....	1 ton of sodium
Ampere efficiency.....	40 per cent
Fall of potential.....	5 v. per cell
Capacity of cells.....	1,200 amp.
Capitalization.....	\$30,000
360 days per year; 24 hours per day.	

#### COSTS PER YEAR

650 tons NaOH @ \$45.....	\$29,250
725 hp.-yr. @ \$20.....	14,500
Thirty men @ \$2 per day per man.....	21,600
Management and expert labor.....	9,000
Interest and depreciation (15 per cent).....	7,500
General expenses and selling, 5 per cent of sale price.....	9,000
Miscellaneous supplies.....	1,000
Total.....	\$91,850
Yearly production, 720,000 lb.....	
Approximate cost per lb.....	12.7c.

In 1905 Edgar A. Ashcroft invented a cell in which he electrolyzed fused soda in one compartment with graphic anode and molten lead cathode; in the second, to which the sodium alloy flowed, he used the above-mentioned alloy as anode and a nickel rod as cathode. By suitable means for controlling the temperature of the alloy, he claimed the possibility of running the process with a bath of molten caustic soda in the second cell.

His current density was 2 to 10 amp. on the anode surface and 10 amp. on the cathode surface; his voltages 8 in the first compartment and about 2 v. in the second. He claimed current efficiencies of between 80 and 100 per cent in both cells under properly regulated conditions.

The lead, after electrolytic separation of the sodium, entered the first compartment for a fresh charge. The idea was novel, but does not seem to be operating on a very large scale.

Fitzgerald described the Castner process as operated by the Niagara Electro Chemical Co. at Niagara Falls, N. Y., under the management of the Roessler & Hasslacher Chemical Co., pointing out particularly the manufacture of oxone from fused sodium peroxide. When treated with water 1 lb. of this substance yields 2.08 cu.ft. of oxygen gas, a fact which has led to its general use in hospitals as a reliable source of gas for resuscitation.

#### CARRIER FUSED SALT CELL

C. F. Carrier in 1906 patented a cell in which he electrolyzed fused salt. (See Fig. 2, taken from U. S. Pat. 830,051; Sept. 4, 1906.) For this purpose he had the anode compartment equipped with graphite anodes and the cathode compartment, which was on the other side of a division wall, equipped with a flat iron plate for cathode. The intermediate electrode was molten lead, which was caused to flow back and forth by the action of two heavy plungers.

The melt in the cathode chamber was fused caustic soda kept just a little above its melting point. The cell was started by piling a little salt around the anode, which was lowered almost to the lead (the latter being in molten condition). When an arc had been formed between graphite and lead, some of the salt melted from the intense heat, and by gradually drawing the anode away from the lead and feeding in salt the bath was built up. Care had to be exercised at this time not to pass the current through the cathode, otherwise the lead would be attacked due to absence of sodium.



When, however, the bath was partly built up, the current was put through the regular channels.

The sodium was deposited in the lead, which conveyed it to the cathode compartment, there to be set free at the iron cathode and collected under paraffine after its exit from the overflow pipe.

To prevent shorting of the current from cathode to

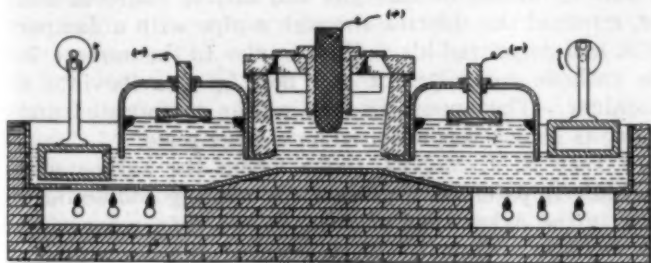


FIG. 2—CARRIER FUSED SALT CELL

bell-covering compartment, a water-cooling pipe was placed on the inner edge of the bell-shaped top of the cathode compartment. This permitted the bath to be kept in solid condition, and hence a good insulator.

One of the chief difficulties which seems apparent in this type of furnace is the control of temperature in the furnace. In spite of the inventor's claims to regulation by means of the water cooling, there still remains the fact that the temperature must drop from about 800 to 300 deg. C. in the space of a few inches. It has also been found that the iron castings do not hold lead tightly and are subject to deterioration, hence it seems like placing too many eggs in one basket.

#### DARLING PROCESS USING SODIUM NITRATE

J. D. Darling had meanwhile invented a process for making metallic sodium from sodium nitrate, carrying on the experimental work at the Philadelphia plant of Harrison Bros. & Co., Inc. Fig. 3 represents the cell as described in U. S. Pat. 517,001; March 20, 1894.

For anodes he used carbon or platinum rods set in compartments with perforated inverted bell of aluminum enveloping them. This bell was fitted with perforations sloping down from the inside to prevent the outward flow of the gases generated during electrolysis. The iron pot served as cathode, air being excluded by a tight cover. Sodium nitrate was melted in the pot, the top cover and electrodes were set in place, and the current was turned on. The molten nitrate was reduced to nitrite of soda with the addition of sodium oxide, the latter dissolving in the nitrite of soda. The nitrite of soda and the sodium oxide were then decomposed, permitting the liberated sodium to float to the top of the bath and pass down through a suitable outlet pipe. Gaseous  $\text{NO}$ , and  $\text{O}$ , passed off through an opening in the top of the anode chamber and were led through absorption bottles containing water, thus forming nitric acid and permitting the oxygen to escape.

He later invented a porous diaphragm of portland cement and improved his cell, and attempted to market his process. Unfortunately the explosion hazard was too great a drawback, and the process was abandoned about the year 1905.

#### MIXED BATHS CONTAINING FLUORIDES

In 1907 Seward and von Kugelgen got out five patents covering bath mixtures and parts of apparatus for making metallic sodium from salt.

The first bath mixture consisted of 4 parts  $\text{CaCl}_2$ , 2 parts  $\text{NaF}$  and 1 part  $\text{BaCl}_2$ , and was considered a great improvement over previous mixtures, which included potassium salts, because the latter contaminated the sodium metal. This bath melted below a red heat and was advantageous because the alkaline earth metal was not decomposed by the potential used.

The second mixture was composed of 15 parts of calcium and sodium fluorides combined with 100 parts  $\text{NaCl}$ . It was found to have a much lower melting point than  $\text{NaCl}$ , and the fluorides had a higher decomposition voltage, hence were practically unconsumed.

The first cell consisted of an iron vessel containing a bath of molten salt. Instead of an iron bottom this pot had one of firebrick or magnesite brick. The anode consisted of the walls of the iron pot and the cathode was molten lead in the bottom of the brick furnace. Halfway down in the cell was an iron wire diaphragm set horizontally in the brickwork so as to separate the anode from the cathode compartment.

During electrolysis the sodium collected on the surface of the electrode and flowed down through an overflow pipe to an outside container; the chlorine attacked the lead, forming lead chloride, which, being heavier than salt, remained at the furnace bottom and was drawn off by a suitable pipe.

One of the main objections to this type of cell is the difficulty of construction and operation. The diaphragm is set rigidly in the furnace walls and cannot be removed

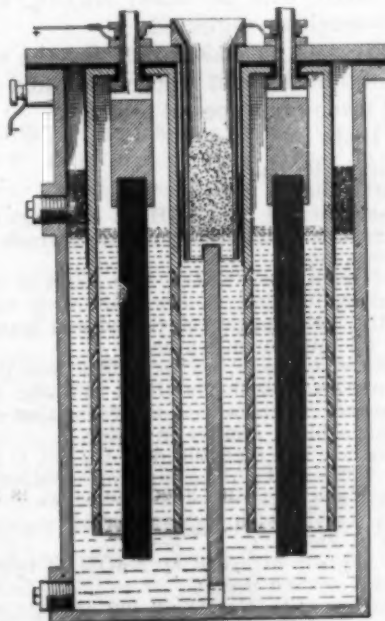


FIG. 3—DARLING CELL USING SODIUM NITRATE

without tearing down the furnace. There is always a large body of sodium on the surface of the bath, which is objectionable.

The second cell consisted of an iron pot as anode lined with magnesite brick at the bottom and fitted with graphite blocks at the top. The cathode is set in the center of the pot surrounded by a water-cooled casting, an arrangement which caused salt to remain molten on the walls of the cathode compartment and prevented leakage and corrosion.

In 1909 G. Van Hevesy made a study of the electrolysis of fused alkalis with especial reference to the

solubilities of the alkali metals in the melt, and arrived at the following tables:

SOLUBILITY OF Na IN NaOH	
Temperature, Deg. C.	Grams Na in 100 g. NaOH
480	33.3
500	10.1
610	9.9
670	9.5
760	7.9
800	6.9

SOLUBILITY OF K IN KOH	
Temperature, Deg. C.	Grams K in 100 g. KOH
480	8.0
700	1.0

In spite of the rapidly decreasing solubility of the Na and K at higher temperatures, the electrochemical efficiencies in electrolysis of NaOH and KOH rapidly decrease with rising temperature as a result of the increase of velocity with which the metal diffuses into the molten electrolyte.

Measurements show this velocity to be greater for sodium than for potassium, and in the former case to increase rapidly above 340 deg. C., at which point the efficiency for NaOH electrolysis sinks nearly to zero.

#### ACTION OF FUSED CAUSTIC ON METALS

At about the same time LeBlanc and Bergmann made a study of the influence of metals on fused caustic, which gave an idea to the chemical engineer as to what to expect in the construction of cells for electrolysis of this chemical.

For the tests they prepared NaOH which analyzed as follows: NaOH, 92.6 per cent;  $\text{Na}_2\text{CO}_3$ , 4.95;  $\text{H}_2\text{O}$ , 2.45. Minor impurities neglected.

The carbonate was not taken out, for the caustic in general use contained about 5 per cent and the tests were not to be made for a special product.

They found that:

Silver is attacked by NaOH.

Gold is not attacked.

Copper is not attacked by NaOH at 435 deg. C., but at 563 deg. C. there was a noticeable reaction which increased at higher temperatures.

Iron does not react with NaOH in a marked manner at 400 deg. C., but at 700 deg. C. the reaction is very lively. After cooling, the melt appears dark red and leaves a dark red precipitate on solution in water.

Copper, on the other hand, leaves a dark blue precipitate. Nickel does not react with NaOH at 400 deg. C., but at higher temperatures it reacts with the formation of a green melt which yields a black residue in water.

Platinum does not react at 400 deg. C., but is somewhat soluble around 700 deg. C. The melt on solution in water leaves behind a black residue.

Zinc acts on NaOH with generation of water and the residue consists of  $\text{Zn}(\text{OH})_2$ .

Aluminum is slightly attacked by NaOH at temperatures ranging from 450 to 500 deg. C.

Magnesium reacts with NaOH at 400 deg. C. in a nickel crucible in a very vigorous manner.

Sodium had to be tried in a nickel crucible, since gold is dissolved in molten condition. It reacts with NaOH at 450 deg. C. in a slight manner, and more vigorously at 550 deg. C. The water solution was made without any gas evolution.

Their results may be summarized as follows:

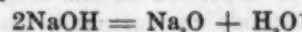
Caustic soda is easily dehydrated at 400 deg. C. in a gold crucible and atmosphere of nitrogen.

Of the metals investigated, gold alone did not act on NaOH in that temperature range on exclusion of air.

Silver and sodium react with hydrogen generation; platinum, copper, iron, nickel, aluminum, zinc and magnesium with hydrogen generation and splitting off of water.

This double reaction is explained in the simplest manner by the existence of the metal and sodium oxide compound from the reaction  $\text{Me} + x\text{NaOH} =$

$\text{Me}(\text{ONa})_x$  with  $\text{Na}_2\text{O}$ , the final product, being a more or less complex one in which water is split off according to the reaction



Danckwardt invented a cell in 1898 containing two compartments, the positive of which was double walled and provided with water cooling. He melted the charge of salt by means of fuel gas and air, or charcoal and air, removed the chlorine through a pipe with a damper in it, and permitted his sodium to rise to the surface in the cathode compartment and flow by gravity into a container. The apparatus was rather complicated and so far as known was not used on a large scale.

In 1910 R. J. McNitt (with whom the author was associated) patented a process for making sodium-lead alloy in the Acker type of furnace and then recovering the metallic sodium by distillation of the alloy under vacuum. This was partly successful and yielded a good grade of sodium.

In 1912 H. Mehner patented a process of reacting sodium carbonate with molten cast iron, which was not electrochemical but of scientific interest.

Marguet in 1913 obtained a French patent in which he said that neither the impurities of the caustic soda bath nor the depositions on the cathode constitute the cause of the drop in yield. It is caused solely by the excessive temperature rise occasioned by re-solution of sodium in the electrolyte.

Seward and von Kùgelgen sought to improve their process by purifying the electrolyte before use in making sodium. They found that small masses of impurities in the salt tended to conduct the current between the poles of the cell and hence defeat the purpose of electrolysis.

By fusing the impure salt and subjecting it to a low current density and high potential, they were able to cause the less electropositive particles to separate out in the bottom of the furnace. The pure salt was then bailed out and used for the final bath.

#### EFFECT OF ADDING SODIUM CARBONATE

B. Neumann made some experiments on mixtures of NaOH and  $\text{Na}_2\text{CO}_3$  in 1914, getting melting point curves showing the varying current efficiencies for his mixtures. The best yields of sodium (83 per cent) were obtained on the addition of 12 to 17 per cent  $\text{Na}_2\text{CO}_3$ , the melting point of the mixture being 280 deg. C.

He also made observations on mixtures of NaOH and NaCl, but the yields were lower than with  $\text{Na}_2\text{CO}_3$ , additions or with pure NaOH. In the best run only 39 per cent current efficiency was obtained, with 5.5 per cent NaCl and melting point of 285 deg. C. He stated that higher efficiencies in the production of sodium in technical practice could be obtained by the careful dehydration of the fused caustic before electrolysis, by the use of NaOH free from NaCl, by the addition of  $\text{Na}_2\text{CO}_3$ , to lower the temperature of the bath, by careful temperature measurements, which until now have been regarded as unnecessary, and by greater attention to the anodic separation of water.

The melting point drops from 296 deg. C. for pure NaOH to 280 deg. C. for the NaOH- $\text{Na}_2\text{CO}_3$  mixture containing 17 per cent  $\text{Na}_2\text{CO}_3$ , rising again to 297 deg. C. for 30 per cent  $\text{Na}_2\text{CO}_3$ .

The current efficiency rises from about 25 per cent at 2 per cent  $\text{Na}_2\text{CO}_3$  to a maximum of 63.03 per cent at 17 per cent  $\text{Na}_2\text{CO}_3$ , decreasing again to 40 per cent at 27 per cent  $\text{Na}_2\text{CO}_3$ .



At the maximum current efficiency the range of temperature between freezing and overheating is also a maximum, being 16 deg. Above this concentration of  $\text{Na}_2\text{CO}_3$  the temperature range gradually diminishes and a factory using these strengths can run with only low efficiencies, if at all. The voltage between the electrodes in this mixture amounted to an average of 6 v.

Caustic soda is found in the industries usually accompanied by some  $\text{NaCl}$ , sometimes up to 3 per cent. Naturally, in continued electrolysis the salt content increases in the cell, since the decomposition point of salt at 300 deg. C. (likewise that of  $\text{Na}_2\text{CO}_3$ ) is about 1 v. higher than that of  $\text{NaOH}$ . The consequence of continued increase of salt content is poorer yields and the necessity for finally discarding the bath.

It was found that in mixtures of salt and caustic the melting point decreased from 289.3 deg. C. with zero salt to a minimum of 283 deg. C. with 7 per cent salt, then rose rapidly to 315 deg. C. with a 15.6 per cent salt content.

Von Wartburg found that no chlorine was generated at the anode with mixtures containing from 25 to 50 per cent  $\text{NaCl}$ .

In 1915 Ashcroft invented a cell in which he made sodium-lead alloy from mixed chlorides of sodium and potassium, and then extracted the potassium by addition of a sodium salt,  $\text{NaCl}$  or  $\text{NaNH}_2$ . The alloy was left with almost pure sodium, and was subjected to electrolysis in a second cell, where the sodium metal was recovered at an iron cathode, the alloy acting as the positive pole.

This was quite an ingenious invention, but, like a great many of the similar sort, very complicated. There were arrangements for stirring the molten salt by the swirl of the current, transfer of the alloy through an intermediate vessel to the second cell and return after impoverishing it of the sodium metal.

Acker in 1915 invented a new process in which he used Ashcroft's idea of the sodium-lead alloy as intermediate electrode, but substituted for  $\text{NaOH}$  as bath in the second cell cyanide or cyanamide of sodium. By this bath he claimed great improvements in efficiency.

#### IMPROVEMENTS IN FUSED SALT PROCESS

Seward and von Kùgelgen obtained patents on improvements in the production of sodium in which they used a shallow cell with graphite anodes set in a ring and stationary iron hollow cathodes set in the furnace bottom and projecting upward to the top of the anodes. (See Fig. 4, which is taken from U. S. Pat. 1,092,178; April 7, 1914.)

On the upper end of the cathode was a nipple for catching the sodium as it overflowed, and covering the cathode space was a head of cast iron suitably projected within the bath by salt maintained in frozen condition by a watercooler encircling the lower edge of the hood. In this way the sodium was prevented from oxidation and allowed to flow through the cathode to a container placed beneath the cathode. The pressure within the cathode hood and the container beneath was maintained the same by connecting the two with a pipe, and any excess pressure due to hydrogen formation was relieved through an oil seal.

A later development of the cathode was one consisting of a double jacket, joined only at the top, the space between being filled with asbestos wool or some other suitable material. This improvement was to avoid the magnetism caused by the current passing in one direc-

tion and holding the sodium against the side of the cathode. In the new cathode the current had to pass upward and then downward, thus destroying the magnetic effect.

Seward made a very thorough discussion of the process of making metallic sodium from fused salt, which is abridged as follows:

For melting the bath in the furnace an alternating current is best, since it avoids the generation of sodium and chlorine gas, until the bath has been built up to the level of the sodium collector. In this way the bath is uncontaminated except from the impurities of the graphite, which may be burned off shortly after start of electrolysis.

An electrolyte melting at about 600 deg. C. was used preferably, with an operating temperature 630 to 679 deg. C., suitable fluxes being added to maintain this

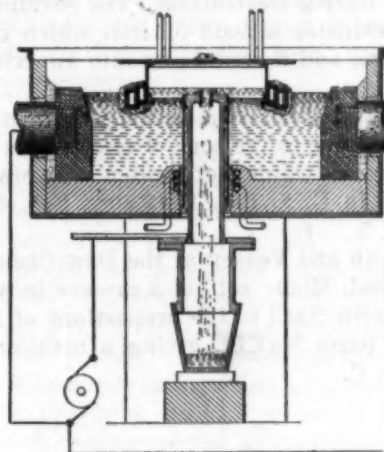


FIG. 4—SEWARD AND VON KÜGELGEN FUSED SALT CELL

melting point. Practically nothing but  $\text{NaCl}$  is electrolyzed, but after a long time there is some slight volatilization and decomposition of the fluxes, necessitating addition of fresh material. After the direct current has replaced the alternating current the output is poor until all moisture is eliminated from the lining, etc., and the electrolyte is completely dehydrated.

The process requires little attention beyond keeping the electrolyte at the proper level and temperature and periodically tapping the sodium from the receiver. Occasionally the appearance of sodium in the anode compartment indicates that the condition of the curtain or of the crucible bottom has become abnormal and corrective methods must be applied. The appearance of sodium outside of the curtain may also indicate that accumulated impurities on the crucible bottom have become active and are separating sodium so remote that it rises outside the sodium chamber. A preliminary refining of the salt, however, renders the accumulation of impurities so slow that this condition appears only at long intervals.

#### DEVELOPMENTS SINCE 1916

J. Brode patented a cell in 1916 in which the anode compartment consisted of a pot lined with firebrick in which were set graphite anodes. The cathode compartment was a bell of iron submerged in the molten salt. The top was airtight, but the lower part was perforated to let the electrolyte circulate with the current. By maintaining a definite pressure inside the cathode chamber the sodium was permitted to rise to the top and flow down into a container which was under slightly less pressure. This apparatus runs into complications in

way of keeping the proper pressure and in being compelled to tear down the furnace to replace the diaphragm.

Pfleger and Ott patented a cell, which was a duplication of the Castner cell, in which they proposed to place a wall of solid salt between the anode and cathode chambers. This was maintained by passing a cool gas through a hollow partition wall which carried the diaphragm.

R. J. McNitt patented in the same year a furnace for making metallic sodium, in which he brought the sodium in molten state to the container by putting the top of the bath under pressure of a neutral gas, such as nitrogen. By this means he claimed to raise the boiling point of the sodium well above its normal value. Sodium boils normally very close to the melting point of salt, and consequently was very likely to be formed in a gaseous cloud during electrolysis. The sodium was permitted to rise inside a hood of iron which carried an iron diaphragm, and flowed down into an external container.

In 1917 McNitt took out a second patent in which he applied the pressure to the zone of electrolysis by means of a superimposed column of molten electrolyte. This cell, described in U. S. Pat. 1,219,808; Feb. 6, 1917, is shown in Fig. 5.

In 1920 Smith and Veasey at the Dow Chemical Co.'s plant in Midland, Mich., got out a process in which they used  $\text{Na}_2\text{CO}_3$  with  $\text{NaCl}$  in the proportions of 35.6 parts  $\text{NaCl}$  to 64.4 parts  $\text{Na}_2\text{CO}_3$ , giving a melting point of about 600 deg. C.

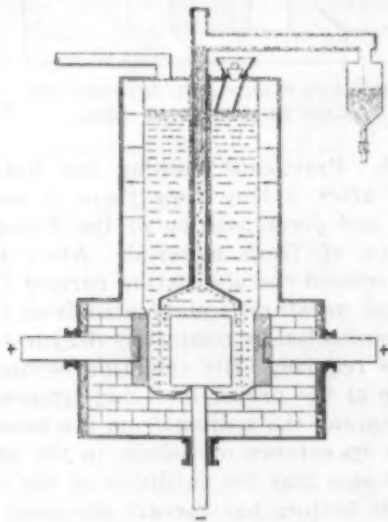


FIG. 5—McNITT CELL

During the years 1917 to 1919 the writer performed a series of experiments on the manufacture of metallic sodium from molten salt at the plant of the Semet Solvay Co. in Syracuse, N. Y., and built furnaces of various designs for the study of the different elements entering into sodium production.

Work along these lines is being investigated by many companies, and the future is bound to bring out new salt processes to compete with the old Castner process, which has almost reached its maximum efficiency.

Of recent years the general dislocation of price levels and labor rates has changed many commercial processes into uneconomical operations, and the production of metallic sodium is no exception. However, the writer believes that the salt process will eventually supersede the caustic soda process, on account of the cheapness and non-corrosiveness of the raw material.

*Part II will be published in a subsequent issue.*

## Electrothermic Zinc Developments

By T. M. BAINS, JR.

SINCE the suspension of experimental work at East St. Louis<sup>1</sup> in 1917, little has been done in dry electrothermic smelting of zinc ores. Further research on zinc condensation was carried on at Case School of Applied Science by C. H. Fulton.

In the fall of 1920 the writer again took up some of the problems which baffled us at East St. Louis and last spring worked out the following improvements:

1. Use of one size of briquet for both cross-connectors and columns, of square or rectangular cross-section.
2. Twelve column set-up of these briquets, for single delta, double "Y" and double delta operation, three phase.
3. Electrodes entering the retort through the top, instead of bottom.
4. Elimination of the costly variable voltage equipment, replacing same by standard transformer equipment.
5. Use of refrax carborundum brick for heating of the condenser.

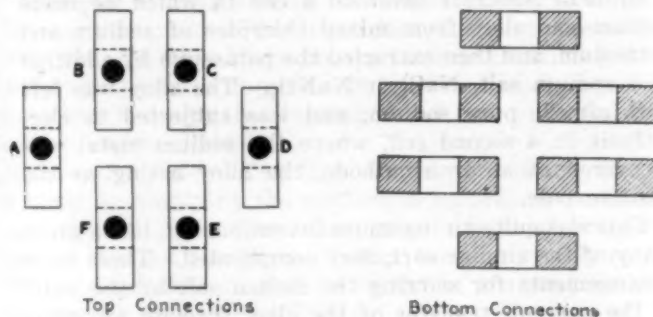


FIG. 1—SKETCH OF CONNECTIONS BETWEEN RESISTORS

By the first improvement, the set-up contains no Acheson graphite or carbon connectors or any material except the briquets. The large, costly graphite connectors used at East St. Louis shown in previous papers were therefore eliminated. By using square or rectangular briquets for cross-connectors and the same size briquets in the columns, a great improvement has been made. The new set-up is shown in Fig. 1. It will be noted that this set-up consists of twelve columns, connected both top and bottom. As the raw briquet on heating softens at about 150 to 200 deg. C. due to the melting of the pitch binder, a height of 6 ft. is probably the maximum limit that can be baked in place. So should a higher set-up be desirable, the baking must be done in two or more steps. The assembly could be considered as made up of "U"-shaped blocks; the lower set of six set bottom down, and the upper set of six set bottom up, on top but rotated through 90 deg. The upper and lower portions of the set-up are identical, except oriented 90 deg. on each other. Briquets of square cross-section are therefore preferable. With this design, the lower half after baking to about 400 deg. C. is strong enough to withstand the weight of the upper half. The latter can be baked in place on top of the lower half.

Electrodes of graphite or carbon are brought through the top of the retort hood and contact is made at the central part of each cross-connector. The base is therefore solid and smooth, instead of containing electrodes,

<sup>1</sup>"Electric Resistance Furnace of Large Capacity," by C. H. Fulton, *Trans., A.I.M.E.*, vol. 64, p. 188; *CHEM. & MET. ENG.*, vol. 22, p. 73; p. 130 (1920).



which must be prevented from oxidizing, when the distilled briquets are removed. Also the electrode "jacks" used at East St. Louis are eliminated.

By the use of six electrodes, one at the center of each of the top connectors, three different connections are obtainable in a three-phase furnace. These are, first, single delta, with four columns in series per phase by joining lines to A, C and E; second, double "Y," with two parallel circuits of two columns each per leg of the "Y" by joining lines to A, C and E and connecting B, D and F as a neutral point; and third, double delta, with two parallel circuits of two columns each across each phase of the delta by joining lines to A, B and C, and connecting A to D, B to F, and C to E. By changing from one set of connections to another and with standard transformers, with 2,300-volt primary and 115/230-volt secondary, from 5.6 to 133 amp. would flow through the briquets, assuming each briquet has a resistance of 1 ohm and that the primary 2,300-volt potential is held constant. The automatic control of current and voltages has been worked out by L. F. Woolston, of the General Electric Co.

Heating the condenser above the melting point of zinc, 418 deg. C., has been a difficult problem. Zinc vapor attacks all metal so far tried, and thus electrical resistors of the nichrome type cannot be used. Carbon and graphite heating elements have been failures. Refractory carborundum brick is not affected by zinc vapor and has been successfully used here. This type of heater was described in the *Engineering and Mining Journal-Press* of April 1, 1922.

Experiments in producing sponge iron from refractory ores high in iron have shown that the residue from the distillation of the zinc contains all the other metals in the form of alloys, principally as ferrosilicon. By crushing this residue and adding it to a  $\text{CuSO}_4$  solution, slightly acidified, the metals in the residue are thrown down with the cement copper and can thus be regained with the copper. It is simpler, however, to use the residue as part of the charge to the lead or copper blast furnace direct.

### Prospects of Polish Steel Industry

The future of the iron and steel industry of Polish Upper Silesia, while apparently assured after a few years, is not regarded as optimistically for the immediate future as that of the coal industry, says Colonel A. B. Barber, technical adviser to Poland, in a statement received by the Department of Commerce. This is due to the fact that a considerable part of the production must at present seek its market in Germany, while in the German market there is the difficulty which existed even before the war of meeting west German competition, chiefly on account of the long distance the greater part of the iron ore must be hauled to Upper Silesia and on account of the inferior strength of Upper Silesian coke when used in blast furnaces (200 tons being a maximum charge as against over 400 tons with Westphalian coke). It is reported that today Westphalian pig iron can be laid down in Upper Silesia at a price lower than Upper Silesian pig iron. The Polish Silesian iron and steel industry will therefore for some time be dependent upon the condition of the industry in Germany, and to secure the Polish market will at times require protection by customs barrier against the German industry.

For the future, however, the prospects of the entire Polish iron and steel industry depend fundamentally

upon the development of an increased demand for iron and steel in ex-Russian Poland, Galicia and neighboring territories (Russia, Rumania, etc.). Before the war the Russian tariff against pig iron was \$15 a ton and against semi-finished iron products \$85 a ton. The annual consumption of iron products in ex-Russian Poland was less than 20 kg. per inhabitant. The use of iron products in Galicia shows only a little less retarded development. The per capita consumption in ex-Prussian Poland, on the other hand, amounted to 80 kg. per annum, in France 90 kg., in Germany 140 kg. and in the United States 300 kg. It seems that an increased demand for iron and steel is likely to develop and if this should reach 60 kg. per inhabitant for all of Poland the amount of iron and steel required annually would be 1,700,000 tons. This is more than the entire production of Poland, including Polish Upper Silesia, leaving out of consideration the demand from Russia and other neighboring countries.

### IRON-ORE PRODUCTION DIMINISHING

While the iron and steel production of Upper Silesia as a whole during the past decade has been constantly in the neighborhood of 1,250,000 tons per annum (of which 70 per cent on the Polish side), the Upper Silesian iron ore production is rapidly becoming insignificant, having fallen to 53,000 tons in 1920. In 1912 the production was 165,000 tons, having decreased steadily from 706,000 tons in 1891.

Upper Silesia has always had to import the essential high-grade ore from Sweden or south Russia, and in recent years, owing to the exhaustion of the Silesian ores, has imported the greater part of her low-grade ores from Germany, together with up to 300,000 tons annually of scrap iron. Polish Upper Silesia will have to continue importing her high-grade ores, but it is expected that within 2 or 3 years the production of ore in the part of Congress Poland lying just to northeast of Upper Silesia (region of Czeszochowa and northwest thereof), where the reserves are estimated at 300,000,000 tons, will be sufficiently developed to take the place of the exhausted Upper Silesian and imported German low-grade ores. During the intervening years, before the supply of iron ore from Polish and south Russian mines can be developed and the use of scrap iron replaced by the use of iron ore, the greatest difficulty for the iron and steel industry in Polish Upper Silesia will be to provide the necessary ore and scrap iron to maintain the production at the present rate. However, it is expected that, in the convention now being negotiated in accordance with the Geneva decision, Germany will undertake for a limited period to continue the supply of the necessary German ores and scrap iron.

### ZINC AND LEAD INDUSTRY

The future of the zinc and lead industry, all of which is on the Polish side, is limited by the ore available, which will be exhausted in a few decades. In 1913, the greatest zinc year, Upper Silesia produced half of Germany's zinc and one-seventh of the world's supply. Now, however, the ore production has fallen from 508,000 tons in 1913 to 266,000 tons in 1920, and this has rendered superfluous a certain portion of the capacity of the reduction plants. A few of the plants have entirely shut down, while the others are working at less than 50 per cent capacity. Despite reduced output Upper Silesia should be able to supply all Polish requirements and leave a large surplus for sale to Germany and elsewhere.

## Recent Chemical & Metallurgical Patents

### British Patents

For complete specifications of any British patent apply to the Superintendent, British Patent Office, Southampton Buildings, Chancery Lane, London, England.

**Yeast Cultivation.**—The parent specification, Br. Pat. 174,625, covers the cultivation medium for distillation yeast. Nitrogen for the growth of yeast is supplied in the form of ammonium salts, or salts of amides or amines, the solution being neutral or very slightly acid. The yeast is aerated during cultivation. A suitable solution contains sugar and ammonium lactate, with sufficient lactic acid to neutralize not more than 0.3 c.c. normal soda solution per 20 c.c. of filtered culture medium.

The addition of oxidizing enzymes is covered by Br. Pat. 174,627. In cultivating yeast in a solution containing compounds of amines or amides as described in the parent specification, oxidizing enzymes are added. A suitable solution contains sugar, carbamide and oxidase. The amides or amine compounds are not necessarily added in a pure state; liquids containing them such as urine and waste waters can also be employed.

The fourth specification of the series describes the addition of the nutrient solution to a vessel containing aerated and fermenting yeast at such a rate that the nutritive substances and the alcohol produced are consumed as fast as they are supplied or formed, the concentration remaining approximately constant. Suitable solutions are (1) a wort formed from mashed maize, malted barley and malt germs, (2) a solution of beet sugar, ammonium lactate, biphosphate of potassium and magnesium sulphate. Br. Pat. 174,625 to 174,628 inclusive. Not yet accepted. N. Muskovits, Nagyvárad, Rumania. March 29, 1922.

**Tanning.**—Hides and skins are tanned by treatment with aqueous acid solutions of the sulphonated products obtained by condensing a carbohydrate with an aromatic hydrocarbon or carbazol or halogen substitution products thereof, the sulphonic acid groups being introduced either by effecting the condensation in the presence of sulphuric acid or by using a sulphonic acid of the cyclic component as reacting material. Natural vegetable tanning agents may also be present. According to the examples, the tanning bath consists of a sulphuric-acid solution of the sodium salt of (1) the product resulting from the condensation of naphthalene, anthracene, phenanthrene,  $\alpha$ -chloronaphthalene, or naphthalene- $\beta$ -sulphonic acid with cellulose in the presence of sulphuric acid, with or without the addition of oakwood extract, (2) the product of the condensation of cellulose and benzene or carbazol in the presence of oleum, or (3) the product obtained by condensing naphthalene with starch, dextrine or grape sugar in the presence of sulphuric acid and anhydrous sodium sulphate. According to the provisional specification, the cyclic component comprises aromatic compounds, or derivatives thereof which are free from hydroxyl. Specification 173,881 is referred to. (Br. Pat. 174,700. Badische Anilin- und Soda-fabrik, Ludwigshafen. March 29, 1922.)

**Purification of Anthraquinone.**—Anthraquinone is purified by solution in cresol or other homologs of phenol and crystallizing. The process may be applied to crude anthraquinone, dry or moist, or to anthraquinone made from phthalic anhydride or by oxidation of anthracene in the presence of a catalyst. The product melts at 287 deg. C. or higher. (Br. Pat. 174,784. British Alizarine Co., London, March 29, 1922.)

**Ammonium Sulphate.**—Neutral ammonium sulphate of good color is obtained by passing ammonia free from sulphuretted hydrogen into mother liquor drained from crystals removed from a saturator in quantity sufficient to neutralize the acid in the mother liquor and the acid in the

crystals, oxidizing the solution, for instance by air, and filtering, then stirring the crystals with the purified mother liquor. The crystals are separated by settling and the mother liquor is decanted with suspended impurities and may be returned to the saturator. (Br. Pat. 174,878. South Metropolitan Gas Co., E. V. Evans and P. Parish, Bromley, England. March 29, 1922.)

**Sodium Hydroxide, Carbonate and Thiosulphate.**—Hydrated sodium sulphide, reduced to powder, reacts with air or oxygen at ordinary temperatures, in the presence of finely divided active charcoal, to give a product containing chiefly caustic soda and sodium thiosulphate. Charcoals sold under the registered trade marks "Eponit" and "Norit" are very active, but fine anthracite coal, animal charcoal and charcoal obtained by the low carbonization of wood, coconut shell, etc., after being activated by treatment with air or steam at low temperatures, are also suitable. If air is employed, the residual nitrogen may be collected as a by-product. After the reaction, the resulting mixture is treated in one of the following ways: (a) The solution obtained by extraction with water is filtered, concentrated and cooled when crystals of thiosulphate and a mother liquor of caustic soda are obtained. The charcoal, after washing, may be used again. (b) The product is leached with alcohol to extract the caustic soda, and then with water to extract the thiosulphate. (c) The solution obtained by lixiviation with water is treated in the cold with carbon dioxide to precipitate the bicarbonate and leave a solution of thiosulphate ready for crystallization. If the carbon dioxide is passed into the hot solution, a mixture of sodium carbonate and thiosulphate is obtained, which is separated by fractional crystallization. (d) The solution, containing from 10 to 40 per cent of sodium compounds, obtained by extraction with water, is electrolyzed, when a solution of caustic soda is obtained at the cathode, and a dilute solution of sulphuric acid and a loose precipitate of sulphur are obtained at the anode. In an example, sodium-sulphide crystals are ground and well mixed with an equal quantity of active charcoal, in an apparatus provided with a water-jacket to prevent the temperature exceeding 100 to 200 deg. C. Steam is evolved and the reaction is allowed to proceed until lead acetate gives a white precipitate with the solution of the product. The latter is extracted with water and subjected to fractional crystallization. (Br. Pat. 174,653. E. E. Naef, W. Bridgford, England, March 29, 1922.)

**Reducing Manganese Ores.**—A process for the production of manganese or manganese alloys low in carbon and silicon from ores in which the principal manganese content is of a higher degree of oxidation than MnO comprises first smelting the ore with such a proportion of carbon that the manganese is reduced to the form MnO, whereafter the ore is finally reduced with silicon, which may be used in the form of silicomanganese or ferrosilicon. Other oxides such as iron oxides present in the ore may be reduced in the first stage by increasing the amount of carbon. Phosphorus may be similarly reduced, iron being added, if necessary, to combine with it. The amount of manganese in the slag formed on reduction with silicon may be diminished by adding lime with the silicon, or by adding lime or limestone to the ore before smelting with carbon. Silica also may be added. (Br. Pat. 174,923. Not yet accepted. Aktiebolaget Ferroleggering, Stockholm. March 29, 1922.)

**Borax and Boric Acid.**—A mixture of sodium pentaborate and a sodium salt is treated with ammonia, borax being formed and crystallized. The borax in the mother liquors serves to liberate the ammonia for re-use with formation of boric acid, which is drawn off and the remaining ammonia (if any) liberated by addition of lime. Calcium borate is recovered as usual. In examples, the theoretical amounts of pentaborate and sodium chloride are dissolved in water at 40 deg. C. and the theoretical quantity of ammonia added. The borax is then either crystallized as much as possible by cooling and the ammonia recovered by lime, or the theoretical amount of borax required to liberate the ammonia is left in solution and the latter boiled, the boric acid separating out. (Br. Pat. 175,201. A. Kelly and R. B. R. Walker, London. April 5, 1922.)



**Tanning.**—Mineral-tanned leather is retanned with organic tanning agents in three stages. After rinsing to remove any uncombined mineral salts, the leather is placed in an organic tanning solution of about 50 deg. Bé., the acid formed in the reaction being continually neutralized with alkali until permanent neutralization is obtained. The second stage consists in treating the product with a solution of an alkali salt of an organic tanning matter until it is thoroughly saturated. The substances incorporated in the leather are finally precipitated by reaction with a corresponding quantity, ascertained by analysis or otherwise, of a solution of neutral or alkaline chromium, iron or aluminum salts, so that the final product does not contain any uncombined metal salts. The leather thus obtained is allowed to rest for a few days, is then rinsed and treated in the usual manner. (Br. Pat. 173,508. Not yet accepted. J. Byston, Holstein, Germany. Feb. 22, 1922.)

**Purifying Lactic Acid.**—The lactic acid or lactate to be purified is first converted into magnesium lactate either by effecting the lactic acid fermentation in presence of magnesium compounds such as carbonate, hydroxide or oxide, or by double decomposition of the more easily soluble lime compound or other soluble lactate with a suitable magnesium compound such as sulphate. The acid is then liberated either by direct acidification with sulphuric acid and extraction with acetone, ether, etc., or the magnesium lactate is suspended in acetone or ether and then agitated with sulphuric acid when magnesium sulphate separates and the solution of lactic acid is evaporated. The product in each case may be purified with bone-black. In examples, commercial lactic acid is treated with magnesia and the resulting lactate treated by each of the above-described methods. (Br. Pat. 173,479. Not yet accepted. J. Schatzkes, Berlin. Feb. 22, 1922.)

**Celluloid Sheeting as Glass Substitute.**—A sheet material applicable as a substitute for glass is made by incorporating a cellulose ether, such as ethyl or benzyl cellulose, or a composition containing the same, with an open-meshed metallic or textile fabric, or with wires, cords, strips, etc. The cellulose compound may be in solution or melted at a temperature of 180 to 200 deg. C. (Br. Pat. 173,021. H. Dreyfus, London. Feb. 8, 1922.)

**Alkali Cyanides.**—Alkali cyanides are produced by passing hydrocyanic acid or gases containing it into a solution of an alkali salt and mixed with lime, the acid radical of the salt being one that forms an insoluble calcium salt. Sodium carbonate and sulphate are suitable, and it is preferred to use a small excess of lime. (Br. Pat. 174,364. Not yet accepted. Deutsche Gold- und Silber-Schneide Anstalt vorm. Rössler, Frankfurt-on-Main. March 22, 1922.)

**Hydroquinone.**—Hydroquinone is manufactured by reduction of quinhydrone by heating either with aqueous ferrous sulphate and an alkaline earth carbonate, or with metallic iron and water. Quinone may be half reduced in the ordinary way and the reduction then completed as described above. (Br. Pat. 174,554. W. Carpmal, London. March 22, 1922.)

## Book Reviews

**MATERIALS OF CONSTRUCTION, THEIR MANUFACTURE AND PROPERTIES.** By the late Prof. Adelbert P. Mills. Second Edition. Edited by Prof. Harrison W. Hayward, Massachusetts Institute of Technology. New York: John Wiley & Sons, Inc., 1922. Price \$4.

Six years ago the reviewer was faced with the problem of teaching metallurgy to engineering students. He assumed that the subject would appeal to them better if presented from the viewpoint that metals are very important materials of construction, and wide differences in properties and general dependability result from differences in the smelting processes, in the chemical analysis and the physical constitution. Young engineers can easily be convinced that they should know something of these things in order to make intelligent selection of materials

which they will some time build into bridges, transmission lines, lathes or autoclaves.

That decision made, the next thing was to find a text book which described both the metallurgy of metals and alloys in the light of modern scientific developments, and their physical properties. Fortunately, Mills' "Materials of Construction" was just off the press; it seemed to cover both the ferrous and non-ferrous alloys in a comprehensive and accurate manner; in fact, it was a veritable godsend.

Now comes the second edition, delayed by Prof. Mills' untimely death. Prof. Hayward has taken great pains to correct the scattered errors in the first edition. Most of the text has been reset. A 30-page chapter on the proportioning, mixing, placing and waterproofing of concrete has been written by Dean Peabody, Jr., while about the same space is occupied by Prof. G. B. Haven in new sections on fiber and wire rope and mechanical fabrics. These are about the only additions. All the text has been gone over with a long blue pencil, so that the new edition has 450 pages against 650 for the first—a cut doubtless necessary to enable the publishers to reduce the selling price to \$4. Such a reduction may give the book a greater sale and thereby increase its usefulness, but will not tempt the owner of the first edition to replace it with a copy of the second.

Since nearly three-quarters of the text is devoted to metallic materials of construction, this portion has suffered most from condensation. At the outset it must be said emphatically that what there is of it is good. It contains very few archaic ideas or incorrect statements such as "Cold-working is beneficial because it closes up the grain of the metal; it also increases the cohesion and adhesion of the crystals," "Most blast furnaces are now equipped with air-drying plants," and that the Domnarfvet and Heroult (California) furnaces are the same. Fortunately, also, the admirable section on non-ferrous metals and alloys has not been compressed very much, and some notes on new alloys like duralumin have been added.

It is too bad, however, that, since the text was to be reset, opportunity was not taken to discriminate between the steels now being used and those which have not yet been adopted. Prof. Mills' concise text seems merely to have been more highly compressed. If space was desired, is it not a shame to get it by cutting down alloy steels to twenty pages, and yet give three to the basic bessemer process, and a few more to details of Stassano and Kjellin electric furnaces? Certainly such widespread and increasingly important materials as alloy steels should not be slighted in favor of foreign processes and furnaces of interest only to expert metallurgists.

Alloy steels have made great advances in the 8 or 9 years since Prof. Mills prepared his original manuscript. He then had to rely largely upon published studies of alloy systems for his data; many of these analyses have not yet found a place in industry. This new edition has not made use of the voluminous literature appearing since that time, and seemingly assumes that all these analyses have, or will have, considerable use, and thus gives the student an entirely erroneous impression on the present state of the art. For instance, considerable space is given to chromium steels ("chrome steel" in the text), while the more important nickel-chromium steels are confined to a half-page tabulation of physical properties of various analyses in the "normal" and "quenched" condition—no indication of the tremendous possibilities of correct heat-treatment. Again, tungsten steels are discussed as though they were used alongside of nickel steel, and only the merest hint that their real importance is as cutting tools, in which, of course, tensile strength is only of minor importance. Furthermore, molybdenum steels containing 1 to 8 per cent Mo are described, whereas the important commercial steels contain less than 1 per cent.

Unfortunately, the only real shortcoming of the first edition has not been corrected. Whereas steel in the abstract is discussed in considerable detail, giving clearly the effect of different impurities, constituents and heat-treatments, nothing is given about those particular kinds of steels which enter into engineering construction in great quantity. Millions of tons of rails, structural shapes,

plates, pipe, steel castings, drop forgings and galvanized sheet are made every year; but not a word can be found about any of these things; no information on the analysis, heat-treatment and properties of steel castings, or on the qualities desired in steel rails or bridge members and how to get them. And until college text books and college instructors talk a lot about steel in particular, as well as steel in the abstract, construction projects will be 10 years behind metallurgical progress, civil engineers will design shapes which cannot possibly be rolled of sound metal, and specifications such as the following will continue to be written (copied):

"Bridge pins over 7 in. diameter shall be forged and annealed; if over 9 in. diameter they shall have a 2-in. hole bored through the center!" E. E. THUM.

#### THE ELEMENTS OF FRACTIONAL DISTILLATION.

By Clark Shove Robinson. International Chemical Series. New York: McGraw-Hill Book Co., Inc. 205 pp., 41 figures. Price, \$2.50.

At least once a year the industries ask the question, "Why do not our universities turn out capable chemical engineers?" The question has been answered in a hundred different ways, but there is one answer that persists year after year. It is, "There are only a few teachers with fundamental knowledge of the subject and with the ability and courage to work out the essential principles and publish the facts."

Prof. C. S. Robinson of the Massachusetts Institute of Technology has had the opportunity to work in the field of distillation. He has realized the need for basic research and with a nice appreciation of the underlying principles he has made a genuine contribution to the science of chemical engineering.

It is true that Prof. Robinson's book on distillation is not a complete work, but it is a solid foundation upon which to build and it is the first time that a book of its kind has ever been written in any language. There are times when, perhaps, the reader wishes a little more could be said on some phase of the subject, but like a wise host, Prof. Robinson does not allow his guest to leave the table with a stuffed feeling but rather with a comfortable feeling of satisfaction and a desire for more.

It is a book you want to own and not a book that you are pleased to see reposing on the dust-covered shelves of a public library. It is a book that answers your questions why and how. It leaves you with the same feeling toward your next distillation problem as the little mouse had who after swallowing two drops of strong liquor, rose on his hind feet and cried loudly, "Now bring on that damn cat!"

There are several typographical errors and a few awkward descriptions that the reviewer has found—mistakes that the average reader can easily rectify for himself. The sub-titles are not as well placed as they might have been, but this does not detract from the value or interest of the book.

A brief outline of the contents can best be expressed in the words of the author:

"In general it has been divided into five parts. The first part deals with fractional distillation from the qualitative standpoint of the phase rule. The second part discusses some of the quantitative aspects from the standpoint of the chemical engineer. Part three discusses the factors involved in the design of distilling equipment. Part four gives a few examples of modern apparatus, while the last portion includes a number of usual reference tables which have been compiled from sources mostly out of print and unavailable except in large libraries."

The first part, dealing with the phase rule, may seem too elementary for some, nevertheless it will be welcomed by others. In a book of this type very little should be taken for granted, otherwise the field for the book will be restricted.

In the second part an attempt is made to derive a few fundamental equations to be used later as a basis for design. Here the reader is led slowly up to the conclusions; he is not jumped from the gas laws to some

complicated expression involving calculus. Many of the equations developed are used in actual calculations in order that the reader will have a clearer vision. There are no mysteries in this book; every attempt is made to simplify the ideas and expressions, in order that the reader will not become puzzled and disgusted. Perhaps the subject matter is made a little too simple; some readers might get the impression that the art of distillation is a finished problem. This class of reader never respects anything the theory of which he can grasp. There is another type of reader that will evaluate correctly this theoretical portion of the book. He will see it only as a foundation to build on; it will act as a catalyst for his own ideas. This is one of the valuable features of the book, it opens up new fields of research to the student.

The third part, to many readers, will contain the "meat" of the text. In this part principles of design based on sound theory and long experience are clearly and simply stated. Every chemical engineer in this country will be interested in this part; they have waited a long while for this and they will not be unappreciative.

The fourth part discusses examples of fractional distillation such as the purification of ammonia and alcohol. Principles of design are illustrated by these examples. It is here that one wishes a little more could be said, a few more suggestions offered.

The fifth part, the appendix, contains several tables of data that have been collected and placed in the book because they are useful and are difficult to find and not because they might be useful and are easy to find.

It is hoped that this is a forerunner of more specialized works by other capable men on various fundamental subjects in chemical engineering. If we could have something similar on filtration, on heat transfer, on drying, on grinding, etc., our young chemical engineer would rise more rapidly, our executives would cease their grumbling, and the chemical industry would be materially advanced.

It is not often that the reader discovers a refreshing bit of unconscious humor concealed in a highly technical treatise, but when he does his appreciation is sincere. The last lines of Prof. Robinson's text are as follows:

"The waste liquor from the bottom of the column *D* flows through the recuperator *B* and then to the sewer."

A masterpiece of clearness and a very clever ending. O. Henry could have done no better. D. B. KEYES.

MODERN GASWORKS PRACTICE. By Alwyne Meade. Second Edition. Rewritten and greatly enlarged. London: Benn Bros., Ltd. 814 pp. 74 illustrations. Price, 55 shillings net.

This second edition represents a 50 per cent increase over the first edition published 5 years ago. This great increase has been necessitated by the many new developments in British gas-engineering practice. The volume is an up-to-date and therefore particularly valuable summary of English gas works equipment and methods.

The practice in English gas works has varied much more in the 5 years past than in the United States. The necessity of war-time fuel economy particularly was a factor necessitating change in quality of gas produced and hence modification in much of the equipment and in methods of operation. The present work emphasizes many of these new practices—for example, devoting a whole chapter to complete gasification of coal and another to cyanogen recovery.

The book deals with production problems only. The author covers these very thoroughly from the retort and generator through to problems of gas holders and storage. Great emphasis is laid upon the mechanical engineering and structural detail. These features are presented very clearly by means of numerous well-selected illustrations.

American gas engineers who plan works or who decide upon matters of technical policy will find much useful material. The work as a whole is rather a text book than a book of reference, and as such it will be appreciated, especially by those who desire to get a broad working knowledge of the engineering tendencies of the day.

R. S. MCBRIDE.



## Technical News of the Week

Current Events in the Chemical, Metallurgical and Allied Industrial Fields—Legislative Developments—Activities of Government Bureaus, Technical Societies and Trade Associations

### Voting Begins on Chemical Schedule— King Assails Tariff and Monopolies

Voting on the items in the chemical schedule of the tariff bill began on May 2. On that date the real discussion of the chemical items began. Prior to that time the reference to the chemical schedule had been of a general character, although the first item, acetic acid, was the basis of extended discussion. It was brought about by a statement on the part of Senator McCumber to the effect that the action of the committee on that commodity permeated the entire bill. The discussion, however, was more political than technical in its character. When it came to a vote, there was no objection to the adoption of the committee's amendment to the first item in the bill. The next item, acetic anhydride, proved to be a snag as well. In the course of the discussion, Senator Smoot mentioned that the existing embargo applies to all synthetic organic chemicals. This seemed to come as a surprise to Senator Jones of New Mexico and to Senator King of Utah, who thereupon proceeded to denounce the dye and chemical control vigorously. Senator King declared that the majority party drove the measure through Congress, claiming it to be necessary to save the dye industry, and in the interest of the national defense. Under this guise, he said, the embargo was made to apply to all the synthetic organic chemicals, which, he declared, was a "patent fraud upon the people."

#### KING DISREGARDS DYE INVESTIGATION FINDINGS

It is very apparent that the evidence before the Shortridge sub-committee has made little impression on Senator King. He is repeating the charges of monopoly in the dye and chemical industry generally in his remarks on the floor of the Senate. In addition, he characterizes the whole tariff bill as absurd, foolish and reactionary. It is sheer madness, he told the Senate, to strike at our foreign trade with such high schedules as are carried by the bill.

"If under the Underwood law," Senator King said, "imports are limited, as they are today, it is hypocrisy to charge that such limited imports menace our industrial and economic security. It is conclusive evidence that the purpose is to cut off all imports, regardless of the effect upon our exports. In the fourth year since the conclusion of the war the balance of trade in favor of our country is relatively greater than before the war. Imports represent an insignificant proportion of the American consumption. The chemical schedule imposes duties upon about 300 different items, covering a wide range of commodities of primary importance. The rates are designed to protect in the sense that they are to be prohibitory, and are intended to operate as an effectual embargo. The rates cannot be warranted from any standpoint of revenue, because the imports in many cases are negligible, not comprising 1 per cent of the domestic production.

#### ADVOCATES WORLD MARKET

"As a matter of general policy," continued Senator King, "the endeavor ought to be to permit the industries of the United States the widest possible range for the selection and procurement of the raw materials of the respective trades, particularly in the field of primary chemicals and chemical compounds. There is scarcely a chemical of wide general use and consumption which we do not produce in superabundant quantities. The surplus must find an outlet in the markets of other countries.

"The aim of the American producer is a large production of standardized products. In the pursuit of this purpose

he has been willing to remit to the foreign technicians the development and the production of the more refined and complex chemical compounds of small relative consumption, for which a wide world market alone warrants the investment of capital for their composition and production."

After citing instances to show that the increases of duty in the chemical schedule range as high as 700 per cent over the present rate, Senator King declared these rates were made in the interest of companies of very large capital. He then proceeded to list a number of chemical companies and to comment on their financial strength.

#### OPPOSITION TO POTASH SCHEDULE

Senator Harris, of Georgia, has introduced an amendment to the tariff bill placing potash on the free list, on the ground that as nearly all potash imports are used in the manufacture of fertilizer the duty proposed in the bill will increase the cost of fertilizer to farmers. The Senate Finance Committee proposed duties for 5 years after enactment of the law, and thereafter the free entry of the product, but the Harris amendment will place the product on the free list immediately.

An amendment by Senator Jones of New Mexico reducing the duty on boric acid from 1½c. to ¾c. a pound was defeated in the Senate by a vote of 26 to 47.

### A.C.S. Committee on Society Procedure Appointed to Improve Organization

At the meeting of the Council of the American Chemical Society during the recent sessions at Birmingham, Ala., a motion was passed to the effect that the president of the society be authorized to appoint a committee of seven to consider various suggestions looking toward improvements in Society procedure, such as the method of election of members, the geographical distribution of directors, the status of the advisory committee and the advisability of intersectional meetings.

President Edgar F. Smith has appointed the following committee to cover this matter: A. V. H. Mory, chairman, 634 Hearst Building, Chicago, Ill.; George L. Coyle, L. C. Drefahl, Graham Edgar, H. C. Parmelee, J. N. Swann and R. E. Swain. The committee will be known as the committee on progress in society procedure and its term is to extend to April, 1923.

The committee will welcome suggestions from members on ways and means of improving society procedure along the above-mentioned lines or on other subjects that might fall within its jurisdiction.

### Dye Investigation Report in Preparation— Hearings Not Officially Closed

The report which will represent the views of the Shortridge sub-committee which has conducted the investigation of the dye industry is being formulated and will be submitted to the full committee immediately on its completion, which probably will be the latter part of this month. It is practically certain that this report will state that the charges of monopoly in the dye industry have not been substantiated.

Senator Shortridge has made it clear that while there must be an end to the investigation, he does not want to stop taking testimony if there is any one else who cares to be heard. Before the investigation is officially closed, H. E. Howe will appear to explain the chemical exhibit in the committee room.

### Substitute for Stanley Patent Bill Proposed by Chemical Engineer

Realizing that compulsory working of patents along the lines suggested in the Stanley bill is too strongly opposed to permit of its becoming a law, Henry Howard, president of the American Institute of Chemical Engineers and chairman of the executive committee of the Manufacturing Chemists' Association, has suggested a substitute. The substitute has been accepted by Senator Stanley.

Mr. Howard's proposal would grant jurisdiction to any United States Circuit Court of Appeals to conduct an investigation upon request of any citizen or firm. Requests for investigation could be made 2 years after the issuance of the patent in cases where the patent is being worked in foreign countries, but not in the United States. The text of the proposed bill is as follows:

That 2 years after the issuance of any United States patent, or at any time after the expiration of that period, if it is shown that the invention covered by such patent is being worked in a substantial manner in a foreign country, and that the owner thereof has failed to work it in the United States, and has refused or refuses to grant licenses thereunder upon such reasonable terms as would make it practicable to practice the patent in the United States, then on the petition of any reputable American citizen, corporation or partnership, exclusive jurisdiction is hereby granted to any United States Circuit Court of Appeals in whose district or circuit the last known residence of the owner of the patent is located, and in the case of an alien the Court of Appeals of the District of Columbia, to investigate upon proper hearing, all the pertinent facts, and the burden of proof shall be upon the owner of the patent to show that he has been and is using reasonable diligence in bringing about the bona fide working of said patent, either himself or through the aid of licenses in the United States, on a scale sufficient to show a bona fide establishment of the industry therein, and upon failure to make such showing, the court shall order a non-exclusive license granted to the petitioner upon such terms as it shall determine to be equitable. The costs therein to be adjudged to be paid by the party against whom the decree is entered.

After the expiration of 3 years of the granting of a license as herein provided and upon the petition of either party in interest, the court which granted the license shall hear the parties with a view to investigating existing conditions and making such changes in the rate of royalty as in its judgment conditions warrant, the expenses of such proceedings to be charged to the party against whom the decision is made; provided, however, that nothing in this act shall be construed to prevent the parties to such a license from agreeing among themselves as to the royalties to be paid.

### Trend of Modern Organic Research Discussed by New York Section

In a delightfully informal and interesting manner, J. F. Norris, professor of organic chemistry at Massachusetts Institute of Technology, addressed the New York Section of the American Chemical Society on May 5 on "The Trend of Modern Organic Research." Prof. Norris remarked that the trend of organic research is shown by the establishment of modern research laboratories by so many companies. It is a significant fact that in a great many cases, professors of organic chemistry have been chosen as directors of these laboratories, showing an appreciation of a need for a complete knowledge of the fundamentals of the subject and of the value of pure scientific research. Another modern indication of this trend is shown by the establishment of research fellowships in various universities by some of the large companies, the recipient being free to choose his subject.

Prof. Norris emphasized the importance of arousing the interest of students in the important developments that grow out of pure science. He declared that the trend of modern research is evidenced by the work of Americans particularly in the field of organic catalysts and accelerators. Developments of increasing industrial significance were discussed such as the hydrogenation of oils, the production of tetra hydro-naphthalene by catalysis, the hydrogenation of

drugs such as glucine, strichnine, etc., the production of anthraquinone by catalysis, the preparation of maleic and succinic acid from benzene, anti-knock compounds of tellurium ethyl, etc., production of butyl alcohol and acetone by fermentation, the synthesis of organic compounds with enzymes and organic synthesis through plant life and photochemistry. In petroleum chemistry the trend is to make petroleum the basis of a series of compounds just as benzene is.

In the discussion which followed L. H. Baekeland emphasized the point that the United States spends more money on research than any other country. He deplored the fact that the research chemists were considered as "dead wood" when business depression came and called this a short-sighted policy. R. H. McKee said that he had observed the average time for research work to bear fruit is about 10 years and in view of this fact entered a protest against a 5-year working clause in the patent laws. G. F. Richmond emphasized the demand in industry for men who are well grounded in organic chemistry rather than its specific applications. M. T. Bogert remarked that growing co-operation is evident both on the part of industries and universities in working with an appreciation of the other's viewpoint.

### Rochester Meeting, Institute of Metals and American Foundrymen

Following is a list of papers on non-ferrous metallurgy to be presented before the joint meeting of the Institute of Metals Division of the American Institute of Mining and Metallurgical Engineers and the American Foundrymen's Association, to be held in Rochester, N. Y., June 5, 1922.

#### INSTITUTE OF METALS DIVISION PAPERS

"Cracks in Aluminum-Alloy Castings," by Robert J. Anderson.

"The Effect of Impurities on the Oxidation and Swelling of Zinc-Aluminum Alloys," by M. M. Pierce and Mr. Brauer.

"Temperature Problems in Foundry and Melting Room," by John P. Goheen.

"Core-Oven Tests," by F. L. Wolf and A. A. Grubb.

"Occurrence of Blue Constituent in High-Strength Manganese Bronze," by E. B. Dix, Jr.

"Gas Absorption and Oxidation of Non-Ferrous Metals," by Bruno Woyski and John W. Boeck.

"Some Interesting Unsolved Problems of the Foundry," by W. M. Corse.

"Foundry Difficulties," by Adolph Bregman.

"Physical Properties of Cartridge Brass," by C. Upthegrove and W. G. Harbert.

"Effects of Impurities on Electrolytic Zinc," by G. D. Scholl.

"Mechanism of Metallic Oxidation at High Temperatures," by N. B. Pilling and R. E. Bedworth.

"Extreme Sensitiveness of the Action of Reducing Atmospheres Upon Heated Copper," by T. S. Fuller.

"Some Electrical Properties of Nickel and Monel Wires," by F. N. Sobast, M. A. Hunter and A. Jones.

#### AMERICAN FOUNDRYMEN'S ASSOCIATION PAPERS

"Aluminum and Aluminum-Alloy Melting Furnaces," by R. J. Anderson, Bureau of Mines, Pittsburgh, Pa.

"Melting Aluminum for Rolling Into Sheet," by J. A. Lange, Western Springs, Ill.

"Use of Secondary Aluminum Ingot in Foundry Practice," by W. M. Weil, National Smelting Co., Cleveland, Ohio.

"Technical Control of McCook Field Foundry," by E. H. Dix, Jr., McCook Field, Dayton, Ohio.

"The Use of Secondary Metal in the Brass Foundry," by C. T. Bragg, Michigan Smelting & Refining Co., Detroit, Michigan.

"Porosity of Non-Ferrous Metals," by R. R. Clarke, Pittsburgh, Pa.

"An Investigation of Segregation With a View to Preventing Its Occurrence in Castings Made of High-Lead Bronze," by Prof. R. E. Lee, Allegheny College, Meadville, Pa.

"Two-Part Castings Made in Three-Part Molds," by W. H. Parry, Brooklyn, N. Y.



### National Research Council Appoints Division Officers for Coming Year

E. W. Washburn, professor of ceramic chemistry and head of the department of ceramic engineering of the University of Illinois, has been selected as chairman of the Division of Chemistry and Chemical Technology of the National Research Council. His term will begin July 1. He succeeds F. G. Cottrell, who has served as chairman during the current fiscal year. Dr. Washburn will serve as editor-in-chief of the Critical Tables of Physical and Chemical Constants. This work will be the principal project of the division during the coming year. Dr. C. J. West will be associated with the division as its executive secretary and as managing editor of the Tables.

Charles L. Reese was selected as vice-chairman of the division. In addition to the chairman and the vice-chairman, the new executive committee is to consist of Wilder D. Bancroft, R. B. Moore, W. C. Geer and Edgar F. Smith. To the members at large of the division were added the names of W. C. Geer, Lauder W. Jones and Edgar F. Smith. Dr. Smith is to complete the term of Dr. Washburn. Acheson Smith, of Niagara Falls, N. Y., was selected as the representative of the American Electrochemical Society.

#### DIVISION OF RESEARCH EXTENSION

M. M. Corse was selected to succeed H. E. Howe as chairman of the Division of Research Extension. W. A. Hamor, assistant director of Mellon Institute, was chosen as vice-chairman of the division. In addition to the chairman and the vice-chairman, the new executive committee of the division will consist of C. E. K. Mees, George C. Stone and F. K. Richtmyer. E. D. Wallen, of Boston, and W. H. Tutwiler, of Philadelphia, were selected to fill vacancies among the members at large of the division.

#### OFFICERS OF OTHER DIVISIONS

Louis A. Bauer, director of the department of terrestrial magnetism of the Carnegie Institution of Washington, was selected as chairman of the executive committee of the American Geophysical Union. Robert M. Yerkes is continued as chairman of the Research Information Service. William Duane, professor of biophysics of Harvard University, was selected as chairman of the Division of Physical Sciences. Alfred D. Flinn was continued as chairman of the Division of Engineering. Frederick P. Gay was selected as chairman of the Division of Medical Sciences. F. R. Lillie becomes chairman of the Division of Biology and Agriculture.

#### FELLOWS ELECTED

Eleven applicants were elected to Fellowships in physics and chemistry at the meeting of the Division of Physical Sciences of the National Research Council, held in Washington April 23. This is in addition to the thirty-two Fellows who did active work last year and who were re-appointed. This work is conducted under the \$500,000 appropriation made to the National Research Council by the Rockefeller Foundation to promote fundamental research in physics and chemistry. These Fellowships are awarded students who have had training equivalent to that represented by the Doctor's degree, and enable numerous exceptional students to continue with research work when otherwise they would have to seek gainful employment.

### Chemists' Club Continues Employment Bureau

As a result of the action of the Council of the American Chemical Society in declining to take over the employment bureau of the Chemists' Club of New York, the latter will continue to operate the bureau as usual. Employers will find here lists of chemists for work in the plant, laboratory or class room, and unemployed chemists will be able to learn of openings in the profession. A moderate fee is charged to applicants but no charge is made to employers. Prof. Herbert R. Moody is in charge of the bureau at 52 East 41st St., New York City.

### Preliminary Program Announced for U. S. Chamber of Commerce Meeting

A preliminary program for the tenth annual meeting of the Chamber of Commerce of the United States to be held in Washington, D. C., May 15 to 18 gives details of the scheduled treatment of the general subject, "European Conditions and Their Effect on American Business." It is predicted that between 4,000 and 5,000 business men will be in attendance.

Monday, May 15, will be devoted to National Council meetings and secretaries' meetings. The latter includes meetings of the National Association of Commercial Organization Secretaries and of the American Trade Association Executives. The former will be addressed by Secretary Hoover, while the trade association men will hear Magnus W. Alexander, managing director, National Industrial Conference Board.

Among the speakers before the general meetings of Tuesday and Wednesday are Joseph H. Defrees, president of the Chamber of Commerce of the United States; Arthur Balfour, vice-president of the Associated Chambers of Commerce of Great Britain; Herbert Hoover, Secretary of Commerce; John R. Howard, president American Farm Bureau Federation; Dwight W. Morrow of J. P. Morgan and Co.; Silas H. Strawn, Montgomery, Ward & Co.; A. C. Bedford, vice-president of the International Chamber of Commerce of the United States, and Albert Thomas, director of International Labour Bureau, Geneva, Switzerland. Each of these speakers will cover a phase of the general topic, so that the symposium should thoroughly cover the economic, financial and industrial aspects of the European situation in respect to the business of America.

The group on foreign commerce, meeting Tuesday and Wednesday afternoons, will hear Frank Taylor, president of the S. S. White Dental Co., on "German Competition" and Julius Klein, chief of the Bureau of Foreign and Domestic Commerce, on "Markets of the Future for Specialties and Staples."

The group on natural resources production is scheduled for a symposium on coal, including mining, labor, selling and transportation problems. A discussion on the extent to which American industries producing raw materials are dependent upon European markets will be led by addresses by C. H. MacDowell, president Armour Fertilizer Works; Sidney J. Jennings, vice-president American Smelting & Refining Co.; J. Leonard Replogle, Empire Steel Co.; Ben B. Woodhead, president Beaumont Lumber Co., and George M. Dexter, president of Dexter & Carpenter, New York City.

Other group meetings include those on civic development, domestic distribution, fabricated production, finance, insurance and transportation and communication.

### A.C.S. Petroleum Research Committee Appointed

The Petroleum Section of the American Chemical Society at the recent Birmingham meeting approved the research outlined by Van H. Manning, director of research for the American Petroleum Institute, and also authorized the appointment of a special committee to co-operate with Dr. Manning in the promotion of research on petroleum. W. A. Gruse, of Mellon Institute, who is secretary of the Petroleum Section, has recently announced that the following chemists have been appointed to serve as members of this committee: W. F. Faragher, chairman, Mellon Institute, Pittsburgh, Pa.; R. E. Wilson, Massachusetts Institute of Technology, Cambridge, Mass.; R. P. Anderson, United Natural Gas Co., Oil City, Pa.; N. A. C. Smith, Bureau of Mines, Pittsburgh, Pa.; C. E. Waters, Bureau of Standards, Washington, D. C.; R. R. Matthews, Roxana Petroleum Co., Wood River, Ill., and E. W. Dean, Standard Oil Co., 26 Broadway, New York City.

It will be recalled that in the general meeting at Birmingham, Dr. Manning presented a paper based on the compilation of about seventy problems of the industry which were indicative of the character and scope of research work which he felt should be undertaken by the petroleum chemists.

### Chemical Problems of the Felt Hat Industry Outlined Before Milwaukee Section, A.C.S.

Problems of interest to chemists and chemical engineers were emphasized by Alan G. Wikoff, industrial editor of *CHEM. & MET.*, in discussing the felt hat industry before the Milwaukee Section of the American Chemical Society, April 28.

Fur is almost universally used as raw material for felt hats. Contrary to popular impression, no wool is used except perhaps in some of the cheapest hats. In the preparation of the fur for the felting operation, it is dampened, and brushed with a solution of mercuric nitrate, and the treated skin dried quickly in heated ovens or chambers. This operation, which is essential to the development of satisfactory felting properties in the fibers, offers a most interesting field for chemical investigation. The mercuric nitrate acts upon the scales on the surface of the fur fibers in such a way that they stand out sharply and thus present a much rougher surface for the interlocking process which produces felt. However, mercuric nitrate is a dangerous poison and since it is dried on the fibers its effects are felt not only in the carroting department but in many of the subsequent operations. Indeed, mercurialism in the form of "hatters' shakes" has long been associated with this industry. It would seem that a careful study of the swelling and shrinking action of different reagents on protein material might lead to the discovery of an efficient but less harmful substitute.

While there is scarcely a department which does not offer problems of interest to the chemist and chemical engineer, those in the carroting room, the dye house and the stiffening room are most evident.

### "Informashow" Offers Interesting Features for Rochester Meeting of Purchasing Agents

The entire group of buildings of Rochester's famous "Exposition Park" has been engaged for the annual convention and exhibition of purchasing agents in that city in order to house a representative exhibition of products. Among the interesting exhibits will be an immense booth planned by the Eagle-Picher Lead Co., showing a complete plant in miniature, engaged in manufacturing sublimed white lead. It is also expected that one of the leading makers of writing paper will have a paper-making plant in operation with a completely equipped laboratory as an educational feature.

This is the first time in the history of the association that the purchasing agents have invited the selling agents to meet them on common ground at an exhibition in connection with their convention. The occasion promises to be unique, as here the manufacturer and his salesmen may display and demonstrate their products to the largest buyers in the country.

Besides the speakers of national reputation who will address the convention on such subjects as "Commercial Bribery," "Arbitration," "Standardization of Coal Contracts," "State and Municipal Purchasing Methods," etc., the group meetings and technical demonstrations will cover many subjects such as iron and steel, cotton, lumber, wool, paper, etc. These group discussions will be led by experts in the various lines.

### Favor Revival of Patent Convention With Germany

After having reviewed the arguments for and against the revival of the patent convention with Germany, the State Department is understood to be inclined to revive the treaty under the authority conferred by the Senate.

The Senate Committee on Patents has reopened its hearings on the working clause bill.

### Oil Chemists' Meeting Postponed

Owing to serious flood condition of the Mississippi River, the annual meeting of the American Oil Chemists' Society, which was to have been held at the Grunewald Hotel, New Orleans, on May 8 and 9, has been postponed to June 5 and 6.

### Recent Oil Developments in Canada

A syndicate which includes Senator N. Currie of Nova Scotia, W. M. Butler of the Canadian Car Co., M. J. Norcross of the Canadian Steamship Lines, General J. W. Stewart of Vancouver and R. N. Wolvin of the British Empire Steel Corporation has been formed to explore a large area of oil lands in the vicinity of Hay River, Alta. Boring operations for oil and natural gas will be started on an extensive scale during the coming summer.

### NEW BOOM IN MANY ISLAND DISTRICT

A heavy flow of wet gas was struck recently in a well that was being sunk by the Medicine Hat Development Co. in the Many Island district, 25 miles northeast of Medicine Hat. The gas was struck at a depth of 1,640 ft., and was so "wet" with gasoline that it had the appearance of steam. The strike has caused such a rush for leases that people stood all night outside the Dominion land office, at Lethbridge, to be among the first to file leases in the morning.

The Canadian Government has recently made some changes in the regulations governing oil and natural gas permits and leases in the Northwest territories. Applications for permits must be accompanied by fees at the rate of 50c. per acre, the rental to be computed on one-half of the area of the location. The time limit on which a permittee must have a drill on the ground located has been extended to 4 years from the previous time limit of 2 years. Rentals for the second, third, fourth and fifth years are placed at \$1 per acre yearly, but provision is made for certain refunds according to the amount of boring that has been done on the location.

### American Society for Testing Materials Announces Program for Atlantic City Meeting

Advance notices of the twenty-fifth meeting of the American Society for Testing Materials have been issued. It will take place at the Chalfonte-Haddon Hall, Atlantic City, N. J. Aside from committee meetings, the various sessions will be as follows:

Tuesday, June 27. Morning: On Non-Ferrous Metals, Metallography and Corrosion. Afternoon: On Wrought, Cast and Malleable Iron. Evening: Presidential address and entertainment.

Wednesday, June 28. Morning: On Steel. Evening: On Impact Testing.

Thursday, June 29. Morning: On Fatigue of Metals and Methods of Testing. Afternoon: On Coal, Coke, Timber and Shipping Containers. Evening: Simultaneous session on Preservative Coatings, and on Concrete Aggregates, Road Materials and Waterproofing.

Friday, June 30. Morning: Simultaneous sessions on Lime, Gypsum and Ceramics, and on Petroleum Products, Insulating Materials, Textiles and Rubber. Afternoon: Golf and tennis tournaments. Evening: On Cement and Concrete.

### Warner-Klipstein Merger Reports Unfounded

Recent rumors and statements in the daily press to the effect that the Warner Chemical Co. interests have taken over the E. C. Klipstein & Sons Co. are entirely without authority and without foundation, according to officials of both companies. The Warner interests never have had nor have they now any financial interest in the E. C. Klipstein & Sons Co., it is stated. There has been no change in the friendly relationship between the companies concerned. The working arrangement between the various companies will continue as heretofore.

### Public Conference on Muscle Shoals

The Southern Commercial Congress has arranged for a series of public meetings at Florence and Sheffield, Ala., May 22 to 24 to consider the projects for the disposal of Muscle Shoals. Legates from all over the country are expected. In view of the decided sentiment through the South in favor of the acceptance of Ford's offer, it is probable that the influence of the conference will be exercised toward that end.



### Tacoma Chemical Club Forms Council for Service to Community and Profession

A significant step toward a more widespread appreciation of the chemical engineering profession was taken recently by the Olympic Chemical Club of Tacoma, Wash. At the regular meeting on April 11, the club adopted a charter creating an active body of five members to be known as the Chemical Engineering Council which will co-operate with other civic organizations in the up-building of the community. The personnel of the first Council is made up of the following: T. J. Porro, J. E. Berkheimer, S. A. Huntington, Douglas Stewart, R. E. Chase and W. Stedman, ex-officio member.

The purpose of the Council, as stated in the charter, is to promote the general welfare of the community in matters pertaining to chemistry and also to promote the welfare of the chemical profession. The duties of the Council include aiding in the development of desirable new industries, assisting in the proper development of established industries, educating and protecting the public in matters pertaining to chemistry and raising the professional ethics of professional chemists and chemical engineers. It is emphasized that the Council will not attempt to give free consulting advice or encroach upon the field of qualified experts.

The Council plans to meet once a week and has already begun to carry out its duties in accordance with its charter, giving evidence of filling a real need in the community.

### Chemical Expenses of Government Reduced—C.W.S. Shows Savings in Varied Fields

Expenditures of government departments dealing with chemistry have been reduced during the year which closes June 30 next, according to a report of the Budget Bureau of Congress. A saving of \$32,000 in expenditures in the Bureau of Chemistry of the Agricultural Department is noted, while larger savings are reported for the Chemical Warfare Service of the army, totaling \$224,431, not counting \$354,380 saved by abandonment of the branch of the service at Lakehurst and its consolidation at Edgewood, Md. At Edgewood there was in addition a saving of \$261,215 by developing more economical operation of the power plant.

In co-operation with the navy in the manufacture of gas masks the Chemical Warfare Service saved the navy \$129,960. The Service is co-operating with other government departments by use of its facilities, resulting in savings. This co-operation includes aid to the Treasury in fumigating ships, assistance to the Bureau of Mines in producing gas masks for industrial purposes, extermination of harmful insects for the Agricultural Department, measurement for the Bureau of Standards of the flow of gas in large meters used in the natural gas fields, and destruction of locusts for the Insular Bureau in the Philippines and of rats in the sugar cane fields of Hawaii.

### Newly Organized Railroad Will Connect Muscle Shoals With Gulf

The Muscle Shoals, Birmingham & Pensacola R.R., organized in Pensacola and charter for operation of which has been granted in Florida, has formally qualified with the Secretary of State of Alabama to engage in business in that state. The proposed railway will connect Muscle Shoals with the Gulf of Mexico, extending from Pensacola northward to a point near Muscle Shoals, with a branch line between Gateswood Junction and Gateswood in Baldwin County. Within the State of Alabama over 300 miles of main track will be constructed, with sidetracks totaling 29 miles.

The railway company is capitalized at \$2,500,000, and under the articles of incorporation filed in Tallahassee, Fla., its indebtedness must not exceed \$250,000. The officers of the company are John T. Steele, Buffalo, N. Y., president; Hubert C. Mandeville, Elmira, N. Y., vice-president, and Roscoe C. Greenaway, secretary. No announcement has been made as to when construction work on the railroad will be started.

### Potash Found in New Area in Texas

The discovery of potash in notable amounts in a new area in Texas is announced by the United States Geological Survey. The new discovery is brought to light through the analysis by the Survey of drill cuttings collected from the Santa Rita No. 1 well, drilled by the Texon Oil & Land Co., in the southwest corner of Reagan County, Texas. Most of the samples contained no potash worth noting, but the sample which, according to the driller's log, was taken from bailings after drilling from 1,150 to 1,165 ft., contained the equivalent of 2.46 per cent of K<sub>2</sub>O; that from 1,175 to 1,182 ft., 5.63 per cent; 1,155 to 1,265 ft., 5.65 per cent; 1,265 to 1,275 ft., 2.50 per cent; 1,275 to 1,283 ft., 6.38 per cent; 1,283 to 1,293 ft., 7.88 per cent; 1,293 to 1,300 ft., 4 per cent; 1,310 to 1,316 ft., 2.05 per cent, and 1,316 to 1,325 ft., 8.29 per cent K<sub>2</sub>O. This, the richest of the samples, indicates 10.78 per cent of K<sub>2</sub>O in the soluble salts when 1 gram of the dry rock is dissolved in 100 c.c. of water.

The well was drilled by standard rig. Accordingly the amount of salt taken in solution by the water used in the process of drilling and bailing is not known. Therefore these cuttings, while significant as disclosing the presence of potash salts in this region, which is 120 miles from the Means No. 1 well in Loving County and 55 miles from the Bryant well in Midland County, where also, according to previous announcements of the Survey, potash deposits are present, do not furnish adequate information as to either the precise thickness of the potash beds or the richness of any considerable thickness of salts penetrated by the drill. Core drilling is needed to furnish definite information.

### Wisconsin Plans Colloid Research and Symposium During Summer Semester Under Svedberg

The University of Wisconsin announces that Prof. The Svedberg, of the University of Upsala, will be in residence for the second semester of the scholastic year 1922-23 and the summer session of 1923.

The chief interest of Prof. Svedberg while at the University of Wisconsin will be the organization and direction of research in colloid chemistry. In addition to this work he will also deliver a series of lectures on the general subject and will conduct seminars for those who are interested in special applications of colloid chemistry.

It is planned to hold a general symposium on colloid chemistry at Madison in June, 1923. Prof. Svedberg will be in charge and papers will be presented and discussed by a number of the leading colloid chemists of America. It is hoped that many who are in the teaching profession and in industrial work may find it possible to attend the symposium and the following 6 weeks of lectures, seminars and research. The summer session opens June 25, 1923, and closes Aug. 3.

### Second Conference on Commercial Engineering Points Out Need of Engineering Training

The second public conference on commercial engineering was held at the Carnegie Institute of Technology, Pittsburgh, Pa., on May 1 and 2, under the direction of the committee on commercial engineering of the United States Bureau of Education. The sessions were featured by a number of addresses by prominent engineers and educators and the discussions were participated in freely by those in attendance.

In a statement embodying the principles which the conference believes to be expressive of proper aims and purposes of educational institutions and industrial organizations, the importance of imparting to engineering students a conception of the breadth of the field was stressed. The desirability of introducing some engineering training in the curricula of schools of commerce and business and of economics and business subjects in engineering schools was emphasized. Better co-operation with the industries in shaping the courses to meet the needs of business for technical executives was recommended.

### English Chemists' Exhibition Scheduled for June

Announcement is made of the twenty-third Chemists' Exhibition, to be held at the Central Hall, Westminster, facing Westminster Abbey, London, S.W., on June 19-23, 1922.

The exhibition will consist of a most comprehensive display of drugs, chemicals and allied goods. It is attended each year not only by the pharmacists of Great Britain and overseas dominions, but by a number of representatives of the drug and chemical trades from other countries.

Anyone interested in this field visiting London during the exhibition week will be assured of a hearty welcome.

### New Steel Development in South Africa Proposed

A group of capitalists in England and South Africa has sent a mining engineer to thoroughly investigate the report that there are important deposits of first-class iron ore and an abundance of coal in South Africa within reasonable distance of each other that might make it profitable for at least one good steel plant. He is just returning to England and states that his investigations have been eminently successful. Deposits of high-grade ore have been proved of sufficient quantity to carry on the industry for 50 of 60 years, while other sources are expected to be developed practically without limit. It is proposed not only to manufacture iron and steel but also to recover tar, sulphate of ammonia, benzene and other byproducts of coke.

## Personal

WILLIAM J. BURGESS has resigned from the Electric Storage Battery Co., Philadelphia, Pa., to accept the position of chemical director of the Pennsylvania Coal Products Co.'s plant at Petrolia, Pa.

THOMAS F. COLE has been elected president of the Seneca Copper Corporation, New York, N. Y., succeeding J. Parke Channing, recently resigned.

F. A. J. FITZGERALD announces that the FitzGerald Laboratories, Inc., has been dissolved. He is continuing his consulting practice at Niagara Falls, N. Y.

LENNART VON FRIESEN, assistant chief engineer of Jernkontoret, the Swedish ironmasters' association, is in the United States for a stay of several months, during which time he hopes to inspect many American metallurgical plants.

C. J. GOODWIN, chemical engineer of London, England, left the end of April for a business tour of Europe. He plans to visit France, Belgium, Switzerland, Austria, Germany and Italy.

W. S. GREENE of Los Angeles is leaving for Mexico, having been engaged as designing engineer by Cia. Minera Mexicana Los Tejones, Yaga, Nayaritt, on the construction of its 250-ton cyanide plant.

Dr. FRANKE HAVENS of the Atlantic Products Co., Philadelphia, Pa., has been elected president of the Philadelphia Chemical Club for the ensuing year. JOHN STUTT, of E. I. du Pont de Nemours & Co., has been elected vice-president; CHARLES A. WAGNER, of the Charles A. Wagner Co., is secretary, and WILLIAM THORN, of Innes, Speiden & Co., is treasurer.

Dr. KUNO B. HEBERLEIN, president of the International Process and Engineering Corporation, New York, is in Europe on an extended business trip.

O. P. HOOD, chief mechanical engineer of the Bureau of Mines, is to spend the summer in Europe investigating recent developments in fuels. He will give special attention to the problems of lignite processing and utilization, in order that the bureau may take account of the latest European developments in planning further work on its special program on lignite.

Prof. J. H. JAMES, head of the department of chemical engineering, Carnegie Technical Institute, and Prof. H. C.

BASHIUM, head of the same department at the University of Pittsburgh, Pa., spoke at the recent meeting of the Pittsburgh Section of the Society for the Promotion of Engineering Education, at Carnegie Tech., on "Chemical Engineering Curricula as They Should Be."

T. A. KLEINFELTER, superintendent at the Tottenville (Staten Island) plant of the Atlantic Terra Cotta Co., resigned May 1, to become general manager at the plant of the J. L. Mott Co., pottery branch, Trenton, N. J. He will be succeeded at the Tottenville works by Frederick Parsons.

Prof. H. R. MOODY of the College of the City of New York has been made director of the department of chemistry in that institution in place of the late Dr. Baskerville.

W. W. ODELL, of the Bureau of Mines fuel division, will spend the summer in North Dakota on a further co-operative agreement between the bureau and Prof. Babcock of the university. It is planned to build another lignite retort for manufacture of lignite char, and the work during the coming summer will deal with the behavior of this new retort and the character of the products which can be made from a low-cost installation. The work is based on the assumption, demonstrated by recent investigations of the bureau, that lignite char can be used direct in certain types of stoves and furnaces without briquetting.

JOHN ORTELL, superintendent of safety at the plant of the Carnegie Steel Co., Pittsburgh, Pa., spoke at the recent annual meeting of the Eastern District of the Portland Cement Association, Allentown, Pa.

Dr. LESTER A. PRATT, who has been in charge of the research laboratory of the Merrimac Chemical Co. for the past 6 years, has been made director of research for the company.

D. A. PRITCHARD, until recently electrochemical superintendent of the United Alkali Co. in England, has been appointed works manager of the Canadian Salt Co., Windsor, Ont., Canada. Mr. Pritchard recently arrived from England and assumed his new duties.

CHARLES L. ROBINSON has become general superintendent of the Simes Leather Co., which has recently taken over the A. H. Walton plant at Bridgton, Me.

HERVEY J. SKINNER, of Skinner, Sherman & Esselen, Inc., sailed for Cuba on April 28 on a trip of inspection of the sugar properties of the United Fruit Co. He will probably be occupied on this work about a month.

Dr. W. R. WHITNEY addressed the Denver Section of the American Chemical Society on May 6, 1922. Members of the American Institute of Electrical Engineers, the Colorado Scientific Society and the Teknik Club were also present.

R. E. ZIMMERMAN, director of the research laboratory of the American Sheet & Tin Plate Co., has been appointed assistant to S. A. Davis, vice-president in charge of operations, succeeding the late Robert Skemp.

## Obituary

PHILIPPE AUGUSTE GUYE, professor of theoretical and technical chemistry at the University of Geneva, Switzerland, died on March 27, 1922. The following biographical data are taken from the *Tribune de Geneve*, March 29: Prof. Guye was born in 1862 at Geneva. At the age of about 30 he discovered the process for the manufacture of nitric acid from atmospheric nitrogen and in 1894, in collaboration with his brother Eugene and Gustave Naville, patented the electric furnace now classic and known as the "four Genevois" for the industrial realization of his discovery. In 1896 he became professor of physical chemistry at the University of Geneva and later professor of theoretical and technical chemistry, the chair he occupied at the date of his death. His most important contribution to chemical science is the study on atomic weights. He was the founder and editor of the *Journal de Chimie Physique* and edited also the magazine *Helvetica Chimica Acta*.



## Market Conditions

### IN CHEMICAL, METALLURGICAL AND ALLIED INDUSTRIES

A Survey of the Economic and Commercial Factors That Influence Trade in Chemicals and Related Commodities—Prevailing Prices and Market Letters From Principal Industrial Centers

#### Foreign Trade and the Business Cycle

The increase in foreign trade during March is regarded as a particularly significant factor in the movement toward business recovery. Exports, which totaled \$332,000,000 in March, represent an increase of 32 per cent over the February figure as against a usual seasonal increase of 2 per cent. Imports in March amounted to \$258,000,000, a 19 per cent increase over the preceding month. According to the Harvard Economic Service, this advance, which is well in excess of the average seasonal rise of 11 per cent, "shows that imports have probably 'turned the corner.' When seasonal influences and long-time trend are eliminated, October, 1921, appears as the low point; the trend since that time has been upward and the increase from January to March has been substantial. This movement is significant, since imports move with the business cycle, and their upturn at this time corroborates the evidence from other sources that substantial business improvement is under way."

#### IMPORTS AND EXPORTS OF CHEMICALS

Imports of dutiable chemicals in March, 1922, were valued at \$3,389,512. The imports of chemicals on the free list were valued at \$5,288,365. The figures for March, 1921, were \$2,241,914 for the dutiable chemicals and \$8,250,542 for free list chemicals. The figures for February, 1922, are \$2,713,180 for dutiable chemicals and \$4,044,647 for those on the free list.

The value of imports of coal-tar products during March of this year is \$681,388. While this is an increase of \$250,000 over February imports, it is more than \$800,000 less than the imports of these products in March, 1921.

The imports of gums continue to increase. March imports aggregated 9,807,459 lb. This is 2,500,000 lb. greater than the February imports and more than 5,000,000 lb. greater than the imports of March, 1921. Imports of specific items which show important variations are as follows:

	March, 1921 Lb.	March, 1922 Lb.
Oxalic acid.....	336,114	465,159
Muriate of ammonia.....	37,514	1,254,481
Sulphide of arsenic.....	376,945	4,325,176
Calcium acetate, etc.....	22,020,963	151,774
Benzene.....	151,774	1,471
Synthetic indigo.....	1,471	16,726
Gum arabic.....	228,654	1,059,626
Synthetic camphor.....	43,691	161,550
Copal.....	1,142,267	2,923,715
Shellac.....	1,530,668	2,009,148
Chloride of lime.....	319,214	1,000,634
Nitrate of potash.....	1,061,620	158,003
Cyanide of soda.....	158,003	1,642,786

The total value of chemicals exported in March was

#### CHEMICAL & METALLURGICAL ENGINEERING'S WEIGHTED INDEX OF CHEMICAL PRICES

Base = 100 for the year July 1, 1913, to June 30, 1914

This week .....	159.77
Last week .....	158.41
May, 1917 .....	222
May, 1920 .....	279
April, 1921 (high) .....	286
April, 1921 (low) .....	140

The continued but gradual rise in the prices of three chemicals of basic importance—viz., caustic soda, caustic potash and soda ash—and the sudden strengthening of the linseed oil market are directly responsible for the unusual increase in this weighted index number.

\$5,389,386. This compares with \$3,803,768 in February and \$4,974,194 in March, 1921. Exports of pigments, paints, and varnishes in March, 1922, were valued at \$1,057,347. This is an increase of nearly \$300,000 over February and exceeds substantially the rate of exportation in March of 1921. There was a slight increase in the exports of fertilizers and fertilizer materials in March of 1922. The increase amounts to about 15,000 tons as compared with February, but is only 2,000 tons in excess of exports in March of last year. There was a very decided increase in explosives exports. The total in March reached 2,113,796 lb., more than double the rate in February. Comparative figures covering a few of the exports are as follows:

	March, 1921 Lb.	March, 1922 Lb.
Benzene.....	10,809,450	13,164,479
Sulphuric acid.....	673,314	1,003,128
Acetate of lime.....	681,050	2,541,897
Calcium carbide.....	576,442	1,106,905
Copper sulphate.....	231,171	915,482
Glycerine.....	164,765	717,833
Magnesium sulphate.....	1,000,013	178,958
Soda ash.....	1,265,411	2,411,745
Caustic soda.....	409,525	18,612,225
Bicarbonate of soda.....	239,403	1,377,158
Zinc oxide.....		535,442

#### Increased Earnings During First Quarter of 1922

**Hercules Powder Co.**—The quarterly statement of the Hercules Powder Co. for the 3 months ended March 31, 1922, is very encouraging. This company's gross receipts during the first quarter of the current year were \$4,243,659.17, as compared with \$2,828,237.70 during the same period of last year. The net earnings from all sources after deducting expenses incident to manufacture and sale, maintenance and repair, depreciation, taxes, etc., was \$375,847.20 in the first quarter of 1922. During the first quarter of 1921 the Hercules company had reported a loss of \$62,400.80.

**Air Reduction Co.**—The gross income of the Air Reduction Co. during the first quarter of 1922 was \$1,369,673.57. After subtracting operating expenses of \$908,718.58 and interest and payment to reserves of \$262,889.77 as well as extraordinary charges to profit and loss of \$5,784.94, the net earnings of the Air Reduction Co. on its outstanding stock of 153,110 shares amounted to \$192,270.28.

#### Changes in Freight Rates on Lead Pigments

The Interstate Commerce Commission has decided that the proposed reductions in freight rates on sublimed lead and certain other pigments from central territory to Eastern points are not justifiable. Reduced rates on red lead and litharge were approved, however, effective May 8.

#### Equipment in the Wood-Distillation Industries

The wood-distillation industries have gone through a number of stages of development in their technology, and this is well reflected in the type of equipment now in use in those industries. The old wasteful charcoal pits were first replaced by brick kilns from which condensable vapors could be recovered. This equipment is still being used, but a great forward step was noted when the use of iron retorts, built in pairs, was inaugurated. A still later improvement followed the introduction of large rectangular ovens, which in many of the larger plants have completely replaced the smaller iron retorts.

The number of retorts, ovens and kilns used by the hardwood distillation industries in 1919 and the steam extraction equipment used in softwood distillation are shown

TABLE I—EQUIPMENT USED IN WOOD-DISTILLATION INDUSTRIES, 1919

State	Aggregate Capacity (Cords)	Kind and Capacity of Equipment					
		Retorts		Ovens		Kilns	
		Number	Total Capacity (Cords)	Number	Total Capacity (Cords)	Number	Total Capacity (Cords)
United States.....	16,088	824	3,140	243	2,008	167	10,070
Hardwood distillation.....	14,684	628	2,676	232	1,938	167	10,070
Michigan.....	9,482	160	1,102	20	180	130	8,200
New York.....	665	188	279	47	386	...	...
Pennsylvania.....	2,118	214	686	159	1,312	12	120
Wisconsin.....	1,832	10	82	...	...	25	1,750
All other states*.....	587	56	527	6	60	...	...
Soft wood distillation.....	1,404	196	464	11	70	...	132
Alabama.....	160	20	10	...	...	...	60
Florida.....	420	18	30	11	70	...	40
Georgia.....	669	76	306	...	...	...	22
Louisiana.....	57	32	40	...	...	...	8
All other states†.....	98	50	78	...	...	...	2

\* Includes Alabama, Connecticut, Kentucky, Mississippi, Missouri, Tennessee and West Virginia.

† Includes Michigan, Mississippi, North Carolina and Texas.

in Table I, which is adapted from the recent bulletin of the Census Bureau on Forest Products.

The production of these industries during the last census year was as follows:

Hardwood distillation products	Quantity
Crude wood alcohol, gal.....	9,103,996
Acetate of lime, lb.....	168,956,432
Charcoal, bu.....	46,354,432
Tar, gal.....	552,124
Tar oils, gal.....	222,398
Wood creosote, lb.....	945,605

\* Includes a small amount of wood alcohol manufactured from softwoods.

Softwood distillation products	Quantity
Rosin, bbl. (280 lb.).....	234,030
Turpentine, gal.....	1,534,333
Tar, gal.....	2,125,757
Tar oils, gal.....	581,042
Charcoal, bu.....	1,702,103
Wood creosote, lb.....	207,050

### New York Market

NEW YORK, May 8, 1922.

A continued active inquiry for solid caustic soda has kept the chemical market in a moderately firm condition during the past week. It is extremely difficult to book any May shipments of standard brands and June contracts are practically sold up. Prussiates have also shown some notable advances, the sodium salt recording a net advance of 1c. per lb. Consuming inquiries have been quite plentiful for copper sulphate and the market throughout the week has shown a decided firmness, with very little prime stock obtainable. Barium products have maintained their recent strength and the market is in relatively light supply at the present time. Small lots of caustic potash are attracting considerable interest and the market has shown a better tone. The chlorates are meeting with a better demand, especially chlorate of soda. Bichromates are moving rather slowly and without any important price variations. Acetate of soda is also considerably stronger. Citric and tartaric acids continue firm, with the latter showing a fractional change. The general market may be summed up as making slow but steady progress in the face of unceasing labor difficulties, the uncertainties surrounding a readjustment of the tariff schedules and the disturbing influences of the coal strike.

### GENERAL CHEMICALS

**Acetate of Soda**—Recent buying of this chemical has noticeably affected spot supplies and sales were reported up to 5c. per lb. Very little material was available and the market was quoted firm at 5@5½c. per lb.

**Amyl Acetate**—Sales are reported on the basis of \$2 per gal. and quotations are heard at \$2@2.25, depending on quantity. The movement is irregular with no special feature to trading.

**Caustic Potash**—Numerous inquiries have reached the market for the 88-92 per cent, and quite a number of small-lot orders have been booked. Several leading sellers quote 6@6½c. per lb. The tendency is for higher prices.

**Caustic Soda**—Firm conditions have developed in the export market and higher prices were noted. Offerings for nearby shipments are very scarce, while the demand is extremely active for consuming requirements in South America, Japan, Germany and Italy. Outside brands of caustic were held at \$3.75@3.80 per 100 lb., May-June shipment. Dealers report sales for domestic consumption at 3½@4c. per lb. Producers quote contracts at 2½c. per lb., basis 60 per cent, carload lots, f.o.b. works. Ground and flake caustic were offered at \$3.65 per 100 lb., f.o.b. works, carload quantities.

**Chlorate of Potash**—Several sales were reported up to 6½c. per lb. for the powdered, while in other directions 6½c. could still be done. Crystals are rather scarce and as high as 8½c. per lb. was quoted. Producers continue to quote 8c. per lb. for immediate shipment.

**Fusel Oil**—Leading sellers quote the crude at \$1.30@1.40 per gal. with some trading reported at the lower figure. Refined is quoted at \$2.15@2.50 per gal., depending on quantity. Demand is moderate.

**Sal Soda**—Producers are booking business on the basis of \$1.20 per 100 lb. in barrels, f.o.b. works. Sales at New York were reported at \$1.40 per 100 lb. Kegs are quoted at 1c. per lb. higher. Demand is not very active.

### COAL-TAR PRODUCTS

The continued strength in phenol has been the feature of the coal-tar market during the past 2 weeks. Spot material toward the end of last week was extremely scarce and the market presented a very firm appearance. Buying conditions in the benzene market continue exceedingly strong, with producers able to quote for future shipment only. Naphthalene is moving quietly with very little change reported. Sales of phthalic anhydride were reported somewhat lower at 35c. per lb. Lower prices were heard for monochlorobenzene, and several sales have gone through as low as 9c. per lb. Producers of salicylic acid reported an advance of 1c. per lb. on both grades. It may be stated in general that business in this market is somewhat irregular and confined mostly to specialties. The tone throughout the list, however, is much steadier than noted a few weeks ago.

**Beta Naphthol**—First-hand sales of the technical grade are reported at 26c. with the general range around 26@27c. per lb. The demand is moderate, with trading mostly in small lots.

**Beta Naphthylamine**—The technical grade is reported quiet at \$1@1.05 per lb. The sublimed grade is quoted at \$1.50@1.60 per lb., depending upon seller and quantity.

**Cresylic Acid**—First-hand sales of the 97-99 per cent are going through at 53@55c. per lb. The 95 per cent dark is moving on the basis of 48c. per gal. The market is reported firm, with a moderate amount of business transacted in small lots.

**Phenol**—Spot material is quoted by dealers at 13½c. per lb., and it is doubtful if better than this price could be done on any available stocks. The demand is very active, with a pronounced tendency of prices going to higher levels.



## The Chicago Market

CHICAGO, Ill., May 4, 1922.

Nothing of interest developed in the industrial chemical market during the past week. Buying is still on a small scale and there is but little evidence of anyone anticipating requirements. Nearly all factors report a fair volume of small business and speculative interests are accumulating stocks of a few commodities. Foreign offers continue to be higher and it is noticeable that the quality is falling off. With these advancing foreign prices it is to be hoped that domestic producers will again be able to operate, but on many items the present selling price is far below the domestic cost of production. The local market as a whole may be characterized as very firm with no one complaining.

### GENERAL CHEMICALS

*Alkalies* showed an increased firmness, with spot stocks more or less depleted. *Solid caustic soda* in small lots was available at \$3.80@4 per 100 lb. and the *ground* at \$4.35 @ \$4.50. *Caustic potash* showed no signs of weakening and only small lots were available at 6½c., while some houses were asking 7c., basis 88-92 per cent. *Soda ash* was firm at \$2.20@2.30 per 100 lb. for 58 per cent material in coopeage.

*Alums* were moving in a routine way and lacked quotable change. *Potash alum* was available at 4½@5½c. for the technical lumps and 6@6½c. per lb. for the U.S.P. powder. *Barium* compounds were exceedingly firm in price and very scarce. *Barium chloride* was quoted in small or moderate quantities at \$110@130 per ton. *Copper sulphate* continued to be in a firm position, although one factor was offering small lots at \$5.75 per 100 lb., city delivery free. *Furfural* was quoted by first hands at 50c. per lb. for quantities in excess of 100 lb. *White arsenic* moved in a small volume at 7½@8c. per lb. The 7½c. material was reported as nearly all absorbed and the general quotation was on the 8c. basis. *Formaldehyde* was dull and neglected at 10c. per lb. for barrels. This figure could very likely have been shaded with a quantity order. *Glycerine* was somewhat easier and it was possible to produce c.p. material at 16c. per lb., bulk basis.

*Bichromate of potash* moved slowly in consuming channels at 11½@13c. per lb. *Soda bichromate*, likewise, moved only in a routine way and was unchanged at 9@9½c. per lb. *Red prussiate of potash* was still unavailable on the spot market and offerings for future delivery were scant. *Yellow prussiate of potash* was scarce and very firm at 32@35c. per lb. *Potash permanganate* was neglected and imported U.S.P. crystals were available at 16c. per lb. *Hyposulphite of soda* moved in a fair volume at \$3.95 per 100 lb. for the pea crystals in single barrel lots.

### LINSEED OIL

*Linseed oil* was reported to be moving in a good volume. Competition was very keen and it was possible to shade regular quotations a cent or two with a good sized inquiry. The boiled oil was offered today in single barrel lots at \$1 per gal. and the raw oil in similar lots at 98c.

### TURPENTINE

A good movement of *turpentine* to the paint trade continued during the week and the market was somewhat firmer. Single barrels were quoted today at \$1 per gal., with the usual reductions for larger quantities or drums.

## The Iron and Steel Market

PITTSBURGH, May 4, 1922.

On the whole, the volume of turnover in the steel market has decreased farther, but in some lines, notably in merchant bars, demand is approximately as heavy as at any time. A general decrease was to be expected from the strong pace of March and the fore part of April, for the rate of buying then was far in excess of both production and consumption.

The demand now seen in the market is of an insistent character, the buyers desiring early deliveries. In not a few instances delivery premiums are offered of, say, \$2 or \$3 a ton, but the tonnage involved is small. The con-

dition makes a striking comparison with the condition of only a couple of months ago, when all divergences from regular prices were downward. As usual, it is the mills that were formerly most disposed to cut prices that are now most disposed to demand premiums.

It is plain that the influence of the coal strike, on the whole, is helpful to the steel market, tending to stiffen prices and to stimulate demand. Buyers seem to have no uneasiness that they may overbuy, but are exhibiting much uneasiness lest they may not receive sufficient deliveries. Through realizing that production is unlikely to increase much in the next 2 months if at all, mills are very firm in their price views, firmer than would have been expected at a time when production in the steel industry as a whole is at only about 70 per cent of capacity.

### PRODUCTION HEAVY

The rate of steel ingot production is probably between 36,000,000 and 38,000,000 tons a year, or slightly heavier than on April 1. The phenomenal increase in production observed in the first 3 months of the year has been largely arrested, but the present rate is likely to continue. Production in December was at a shade under 20,000,000 tons a year, the rate rising to about 30,000,000 tons on March 1 and to 35,000,000 tons on April 1.

Since April 1 production of pig iron and steel in the immediate Pittsburgh district has decreased a trifle, but has been above the average of March. The Mahoning Valley and the Wheeling district have lost a trifle in production, while the Chicago and some other districts have had sharp gains.

The Carnegie Steel Co. has been operating thirty-two blast furnaces in the past fortnight, against thirty-four on April 1. The company's steel ingot production last week was 75 per cent of capacity, against 71 per cent the preceding week.

The regular market on steel products is as follows: Bars, shapes and plates, 1.50c.; bands, hoops and hot-rolled strips, 2c.; standard steel pipe, 71 per cent basing discount; blue annealed sheets, 2.40c.; black sheets, 3.15c.; galvanized sheets, 4.15c.; tin plate, \$4.75; plain wire, 2.25c. On nails there are two prices, the independents holding to \$2.50, according to their advance about 3 weeks ago, and the American Steel & Wire Co. adhering to the old price of \$2.40, at which price it is carefully selecting its bookings. In occasional instances higher prices than quoted here are being paid, but only on small lots.

Billets and sheet bars are not obtainable at prices commensurate with those ruling on finished products, as the mills are not regular sellers, feeling that their previous commitments together with current sales of finished products will absorb all their possible production. Sheet bars might possibly be picked up at \$33, but \$35 seems a more probable figure, comparing with \$29 in March. Report has it that 1,000 tons of billets have been bought at \$32.50 Pittsburgh.

### PIG IRON MARKET

There can scarcely be said to be any regular demand for pig iron, and there is no clearly defined market. Buyers know in general approximately what they would have to pay on forced purchases and are quite unwilling to consider such prices. They will exhaust their stocks before making any commitments, in the hope that meanwhile conditions will ease off. It chances that the strikes in the Connells-ville region have affected the operation of merchant furnaces in Pennsylvania and Ohio more than the operation of steel works furnaces. Not many were in blast and some of these have had to bank, the result being that furnaces are not openly quoting prices at all. A guess is that about \$24, valley basis, would have to be paid on a forced purchase of bessemer, basic or foundry, which compares with prices ruling April 1 of \$19.50 on bessemer, \$18 on basic and \$19 on foundry, valley basis.

Connellsville coke is offered in a very limited way and there is likewise a very limited demand, on account of high prices. The market is quotable 25c. higher than a week ago, at \$6.25 for furnace and \$6.75 for foundry coke.





Ortho-nitro-toluene.....	lb.	.12	—	.15
Ortho-toluidine.....	lb.	.16	—	.20
Para-amidophenol, base.....	lb.	1.25	—	1.30
Para-amidophenol, HCl.....	lb.	1.30	—	1.35
Para-dichlorobenzene.....	lb.	.14	—	.16
Paranitroaniline.....	lb.	.75	—	.77
Para-nitrotoluene.....	lb.	.60	—	.70
Para-phenylenediamine.....	lb.	1.50	—	1.55
Para-toluidine.....	lb.	1.05	—	1.15
Phthalic anhydride.....	lb.	.35	—	.38
Phenol, U. S. P., drums.....	lb.	1.13	—	1.15
Pyridine.....	gal.	1.75	—	2.25
Resorcinol, technical.....	lb.	1.30	—	1.35
Resorcinol, pure.....	lb.	1.75	—	1.80
Salicylic acid, tech., in bbls.....	lb.	.25	—	.25
Salicylic acid, U. S. P.....	lb.	.26	—	.26
Solvent naphtha, water-white, in drums, 100 gal.....	gal.	.25	—	.28
Solvent naphtha, crude, heavy, in drums, 100 gal.....	gal.	.10	—	.12
Sulphanilic acid, crude.....	lb.	.24	—	.26
Tolidine.....	lb.	1.20	—	1.30
Toluidine, mixed.....	lb.	.30	—	.35
Toluene, in tank cars.....	gal.	.25	—	.28
Toluene, in drums.....	gal.	.30	—	.35
Xylidines, drums, 100 gal.....	lb.	.40	—	.45
Xylene, pure, in drums.....	gal.	.40	—	.45
Xylene, pure, in tank cars.....	gal.	.45	—	.45
Xylene, commercial, in drums, 100 gal.....	gal.	.33	—	.35
Xylene, commercial, in tank cars.....	gal.	.30	—	....

### Waxes

All quotations same as previous report

### Naval Stores

All prices are f.o.b. New York unless otherwise stated, and are based on carload lots. The oils in 50 gal. bbls., gross weight, 500 lb.

Rosin B-D, bbl.....	280 lb.	\$5.15	—	\$5.20
Rosin E-I.....	280 lb.	5.25	—	5.30
Rosin K-N.....	280 lb.	5.35	—	6.50
Rosin W. G. W. W.....	280 lb.	7.00	—	7.25
Wood rosin, bbl.....	280 lb.	6.25	—	....
Spirits of turpentine.....	gal.	.86	—	.86
Wood turpentine, steam dist.....	gal.	.85	—	....
Wood turpentine, dest. dist.....	gal.	.70	—	.70
Pine tar pitch, bbl.....	200 lb.	....	—	6.00
Tar, kiln burned, bbl. (500 lb.).....	bbl.	....	—	10.00
Retort tar, bbl.....	500 lb.	....	—	9.00
Rosin oil, first run.....	gal.	.37	—	....
Rosin oil, second run.....	gal.	.39	—	....
Rosin oil, third run.....	gal.	.46	—	....
Pine oil, steam dist., sp.gr. 0.930-0.940.....	gal.	....	—	1.90
Pine oil, pure, dest. dist.....	gal.	....	—	1.50
Pine tar oil, ref., sp.gr. 1.025-1.035.....	gal.	....	—	.46
Pine tar oil, crude, sp.gr. 1.025-1.035 tank cars f.o.b. Jacksonville, Fla.....	gal.	....	—	.35
Pine tar oil, double ref., sp.gr. 0.965-0.990.....	gal.	....	—	.75
Pine tar, ref., thin, sp.gr. 1.080-1.960.....	gal.	....	—	.35
Turpentine, crude, sp. gr. 0.900-0.970.....	gal.	....	—	1.25
Hardwood oil, f.o.b. Mich., sp.gr. 0.960-0.990.....	gal.	....	—	.35
Pinewood creosote, ref.....	gal.	....	—	.52

### Fertilizers

Prices remain quotably unchanged

### Crude Rubber

Para-Upriver fine.....	lb.	\$0.19	—	.19
Upriver coarse.....	lb.	.13	—	.14
Upriver caucho ball.....	lb.	.14	—	.14
Plantation—First latex crepe.....	lb.	.16	—	.16
Ribbed smoked sheets.....	lb.	.16	—	.16
Brown crepe, thin, clean.....	lb.	.14	—	....
Amber crepe No. 1.....	lb.	.16	—	....

### Oils

#### VEGETABLE

The following prices are f.o.b. New York for carload lots.

Castor oil, No. 3, in bbls.....	lb.	\$0.10	—	\$0.10
Castor oil, AA, in bbls.....	lb.	.11	—	.12
China wood oil, in bbls.....	lb.	.14	—	.14
Cocoonut oil, Ceylon grade, in bbls.....	lb.	.08	—	.09
Cocoonut oil, Cochon grade, in bbls.....	lb.	.09	—	.09
Corn oil, crude, in bbls.....	lb.	.11	—	.11
Cottonseed oil, crude (f. o. b. mill).....	lb.	.09	—	.10
Cottonseed oil, summer yellow.....	lb.	.12	—	.12
Cottonseed oil, winter yellow.....	lb.	.13	—	.13
Linseed oil, raw, car lots (domestic).....	gal.	.90	—	.91
Linseed oil, raw, tank cars (domestic).....	gal.	.86	—	.87
Linseed oil, in 5-bbl lots (domestic).....	gal.	.93	—	.94
Olive oil, denatured.....	gal.	1.15	—	1.17
Palm, Lagos.....	lb.	.07	—	.07
Palm, Niger.....	lb.	.06	—	.06
Peanut oil, crude, tank cars (f.o.b. mill).....	lb.	.09	—	.10
Peanut oil, refined, in bbls.....	lb.	.12	—	.13
Rapeseed oil, refined in bbls.....	gal.	.83	—	.84
Rapeseed oil, blanch, in bbls.....	gal.	.86	—	.87
Soya bean oil (Manchurian), in bbls. N. Y.....	lb.	.11	—	....
Soya bean oil, tank cars, f.o.b. Pacific coast.....	lb.	.09	—	....

#### FISH

Light pressed menhaden.....	gal.	\$0.54	—	....
Yellow bleached menhaden.....	gal.	.57	—	....
White bleached menhaden.....	gal.	.56	—	....
Blown menhaden.....	gal.	.61	—	....

### Miscellaneous Materials

All f.o.b. New York Unless Otherwise Stated

Asbestos, crude No. 1, f.o.b., Quebec, Canada.....	short ton	\$750.00	—	\$900.00
Asbestos, shingle stock, f.o.b., Quebec, Canada.....	short ton	60.00	—	110.00
Asbestos, cement stock, f.o.b., Quebec, Canada.....	short ton	14.00	—	17.50
Barytes, ground, white, f.o.b. mills.....	net ton	17.00	—	23.00
Barytes, ground, off color f.o.b. mills.....	net ton	13.00	—	21.00
Barytes, floated, f.o.b. St. Louis.....	net ton	23.00	—	24.00
Barytes, crude f.o.b. mines.....	net ton	8.00	—	8.00
Casein.....	lb.	.10	—	.12
China clay (kaolin) crude, f.o.b. mines, Georgia.....	net ton	6.00	—	8.00
China clay (kaolin) washed, f.o.b. Georgia.....	net ton	8.00	—	9.00
China clay (kaolin) powdered, f.o.b. Georgia.....	net ton	12.00	—	20.00
Feldspar, No. 1 crude f.o.b. Virginia points.....	net ton	8.00	—	12.00
China clay (kaolin) ground, f.o.b. Virginia points.....	net ton	13.00	—	20.00
China clay (kaolin), imported, lump.....	net ton	14.00	—	20.00
China clay (kaolin), imported, powdered.....	net ton	30.00	—	35.00
Feldspar, No. 1 pottery grade.....	long ton	6.50	—	6.75
Feldspar, No. 2 pottery grade.....	long ton	5.75	—	5.90
Feldspar, No. 1 soap grade.....	long ton	7.00	—	7.50
Feldspar, No. 1 Canadian, for mill.....	long ton	21.00	—	22.00
Graphite, Ceylon lump, first quality.....	lb.	.06	—	.07
Graphite, Ceylon chip.....	lb.	.04	—	.05
Graphite, high grade amorphous crude.....	ton	15.00	—	30.00
Kieselguhr, f.o.b. mines, Cal.....	per ton	40.00	—	....
Kieselguhr, f.o.b. N. Y.....	per ton	55.00	—	60.00
Magnesite, calcined (crude).....	per ton	8.00	—	12.00
Pumice stone, imported.....	lb.	.03	—	.05
Pumice stone, domestic, lump.....	lb.	.05	—	.05
Pumice stone, domestic, ground.....	lb.	.06	—	.07
Shellac, orange fine.....	lb.	.79	—	.80
Shellac, orange superfine.....	lb.	.81	—	.82
Shellac, A. C. garnet.....	lb.	.72	—	.73
Shellac, T. N.....	lb.	.78	—	.79
Silica, glass sand, f.o.b. Indiana.....	per ton	1.25	—	2.25
Silica, and blast material, f.o.b. Indiana.....	per ton	2.25	—	4.50
Silica, amorphous, 250 mesh, f.o.b. Illinois.....	per ton	16.00	—	16.00
Silica, building sand, f.o.b. Pa.....	per ton	2.00	—	2.75
Soapstone.....	ton	12.00	—	15.00
Talc, 200 mesh, f.o.b. Vermont.....	ton	7.00	—	12.00
Talc, 200 mesh, f.o.b. Georgia.....	ton	7.50	—	12.00
Talc, 200 mesh, f.o.b. Los Angeles.....	ton	16.00	—	20.00

### Refractories

Bauxite brick, 56% Al, f.o.b. Pittsburgh.....	per 1,000	\$130.00	—	....
Carborundum refractory brick, 9-in.....	1,000	1100.00	—	....
Chrome brick, f.o.b. Eastern shipping points.....	net ton	40-41	—	....
Chrome cement, 40-50% Cr <sub>2</sub> O <sub>3</sub> .....	net ton	30-32	—	....
Chrome cement, 40-45% Cr <sub>2</sub> O <sub>3</sub> , sacks, in car lots, f.o.b. Eastern shipping points.....	net ton	30-32	—	....
Fireclay brick, 1st quality, 9-in. shapes, f.o.b. Pennsylvania, Ohio and Kentucky works.....	1,000	32-35	—	....
Fireclay brick, 2nd quality, 9-in. shapes, f.o.b. Pennsylvania, Ohio and Kentucky works.....	1,000	27-30	—	....
Magnesite brick, 9-in. straight (f.o.b. works).....	net ton	53	—	....
Magnesite brick, 9-in. arches, wedges and keys.....	net ton	70	—	....
Magnesite brick, soaps and splits.....	net ton	90	—	....
Silica brick, 9-in. sizes, f.o.b. Chicago district.....	1,000	30-32	—	....
Silica brick, 9-in. sizes, f.o.b. Birmingham district.....	1,000	33-35	—	....
Silica brick, 9-in. sizes, f.o.b. Mt. Union, Pa.....	1,000	27-30	—	....

### Ferro-Alloys

Quotations remain same as previous report

### Ores and Semi-finished Products

All f.o.b. New York, Unless Otherwise Stated

Coke, foundry, f.o.b., ovens.....	net ton	\$6.50	—	....
Coke, furnace, f.o.b., ovens.....	net ton	6.00	—	....

All other prices same as previous report

### Non-Ferrous Metals

#### New York Markets

		Cents per Lb
Copper, electrolytic.....	oz.	13.00
Aluminum, 98 to 99 per cent.....	lb.	19.00
Antimony, wholesale lots, Chinese and Japanese.....	lb.	5.50
Nickel, ordinary (ingot).....	lb.	36.00
Nickel, electrolytic.....	lb.	39.00
Nickel, electrolytic, resale.....	30.00-33.00	....
Monel metal, shot and blocks.....	lb.	32.00
Monel metal ingots.....	lb.	35.00
Monel metal, sheet bars.....	lb.	38.00
Tin, 5-ton lots, Straits.....	30.875	....
Lead, New York, spot.....	5.25	....
Lead, E. St. Louis, spot.....	5.125	....
Zinc, spot, New York.....	5.475	....
Zinc, spot, E. St. Louis.....	4.975	....

#### OTHER METALS

Silver (commercial).....	oz.	\$0.70	—	....
Cadmium.....	lb.	1.00-1.10	—	....
Bismuth (500 lb. lots).....	lb.	2.00-2.10	—	....
Cobalt.....	lb.	3.00-3.25	—	....
Magnesium.....	lb.	1.15	—	....
Platinum.....	oz.	85.00-90.00	—	....
Iridium.....	oz.	150.00-170.00	—	....
Palladium.....	oz.	55.00-60.00	—	....
Mercury.....	75 lb.	55.00	—	....

# Industrial

Financial, Construction and Manufacturers' News

## Construction and Operation

### California

**SANTA BARBARA**—The City Council is planning for extensions and improvements in the water system, including filtration apparatus, etc., estimated to cost about \$240,000. Fred L. Johnston is city manager.

### Connecticut

**NEWFIELD**—The Tuttle Brick Co., Middletown, Conn., has acquired the brick-manufacturing plant of James C. Lincoln at Newfield, including about 75 acres of adjoining property, for a consideration said to be \$60,000. The new owner will operate the plant, and plans for a number of extensions and improvements.

### Delaware

**SMYRNA**—Extensions and improvements will be made to the plant and system of the Smyrna Gas Co., recently acquired by John V. Postles and associates. A company has been organized to operate the plant.

### Georgia

**CONCORD**—The R. H. Strickland Co. has plans under way for the rebuilding of its fertilizer plant, recently destroyed by fire, with loss approximating \$75,000. G. E. Strickland is in charge.

### Indiana

**HAMMOND**—The Jones & Laughlin Steel Co., 3rd Ave., Pittsburgh, Pa., has completed the purchase of property at Hammond, totaling about 1,000 acres of land, for a consideration approximating \$750,000. It will be used as a site for a new steel works, estimated to cost in excess of \$10,000,000. Plans are under way for the initial structures; no announcement has been made regarding the time of erection.

**HAMMOND**—Fire, April 25, destroyed a portion of the plant of the Wanner Malleable Iron Co., manufacturer of iron castings and kindred products, with loss estimated at about \$80,000, including equipment. It is planned to rebuild at an early date.

### Iowa

**DES MOINES**—The Des Moines Gas Co. is planning for the construction of a new gas plant, with gas holder of about 2,500,000 cu. ft. capacity, and general manufacturing equipment. The estimated cost has not been announced.

### Kansas

**LEAVENWORTH**—The Great Western Mfg. Co., manufacturer of machinery, has preliminary plans under way for the construction of a 2-story and basement addition at 2nd and Choctaw Sts., to be equipped as an enameling plant. W. P. & M. K. Feth, Leavenworth, are architects.

### Louisiana

**ALEXANDRIA**—The Old Dominion Glass Co. has commenced the rebuilding of its plant, recently destroyed by fire. New equipment will be installed.

**ALEXANDRIA**—The City Council is arranging for a special election to vote bonds for \$110,000 for a municipal gas plant and system.

**HOUMA**—John O. Trahan, Houma, is organizing a company to construct and operate a local plant for the manufacture of paper products from sugar cane refuse. A sugar mill will also be erected.

### Maine

**PHIPPSBURG**—The Basin Quarries, Inc., Portland, Me., recently organized, has acquired a local tract of feldspar property, comprising about 100 acres, and plans for the installation of a mining and refining plant, including crushing, grinding, pulver-

izing and other equipment. Joseph F. Perry, Portland, heads the company.

### Maryland

**BALTIMORE**—The Rennous-Kleinle Division of the Pittsburgh Plate Glass Co., 3221 Frederick Ave., has awarded a contract to the Consolidated Engineering Co., Calvert Bldg., for the erection of its proposed new 4-story and basement plant, 62 x 95 ft., estimated to cost about \$50,000. Work will be commenced at once.

**CUMBERLAND**—Fire, April 26, destroyed the chemical works and laboratory of Alexander Sloan, located in the building at Baltimore and Center Sts., with loss estimated at about \$30,000.

**EASTON**—The Easton Gas Co. is arranging for extensions and improvements in its artificial gas plant and system. The property is operated by Kitzmiller Brothers, Shippensburg, Pa. The work has been ordered by the State Public Service Commission.

### Massachusetts

**CAMBRIDGE**—Fire, April 27, destroyed a section of the plant of the Whittemore Brothers Corp., Albany St., manufacturer of polishes, with loss estimated at about \$65,000, with machinery. The bulk of the damage was confined to the mixing department. It is planned to rebuild at an early date.

**LYNN**—Fire, April 28, destroyed a portion of the plant of the Ryan Ideal Stain & Blacking Co., Washington St., with loss estimated at about \$50,000, including equipment.

### Michigan

**CHEBOYGAN**—The Cheboygan Brick & Tile Co. is considering a proposition for the sale of its plant to other interests. It is said that the prospective owners will resume operations at an early date, and plan to make a number of improvements.

### Mississippi

**LAUREL**—The Continental Turpentine & Rosin Co. has preliminary plans under way for the rebuilding of the large portion of its plant destroyed by fire, April 25, with loss estimated at about \$100,000, including equipment.

### Missouri

**IRONTON**—The Iron Mountain Co. is planning for the construction of a new iron ore works, including crushing, separating and other departments, estimated to cost about \$500,000, including machinery. It is proposed to develop a capacity in excess of 5 cars per day.

**POPLAR BLUFF**—The Poplar Bluff Rubber Co., recently organized with a capital of \$100,000, has plans under way for the construction of a new local plant for the manufacture of inner tubes for automobile tires, and other rubber products. Roy E. Nieman and J. J. Wehlgemuth, Maplewood Post-office, St. Louis, Mo., head the company.

**POPLAR BLUFF**—The Iron Exploration Co., a subsidiary of the St. Louis Coke & Chemical Co., Granite City, Ill., is considering the installation of a new crushing and washing plant, with crusher, grinding and other equipment. Plans will be prepared at an early date.

### New Jersey

**TRENTON**—The Ajax Rubber Co., Breunig Ave., manufacturer of automobile tires, etc., has filed plans for the erection of a 1-story addition.

**NEWARK**—The H. G. Mooney Co., 356 Mulberry St., paper products, has completed plans for the construction of a new 1-story building at Frelinghuysen Ave. and Willow St., to cost about \$30,000.

### New York

**NIAGARA FALLS**—The Paper Converting Corp., Royal Ave., is considering the erection of a new 2-story building at its plant, 50 x 80 ft. Plans will be prepared at an early date.

**NEW YORK**—In connection with the recent acquisition of the West India Oil Refining Co. of Kentucky by the Standard Oil Co. of New Jersey, 26 Broadway, the latter organization will secure an oil refinery at Havana Harbor, Cuba, and has plans under way for extensive operations at this point, with proposed plant improvements.

**NORTH TONAWANDA**—The Board of Water Commissioners is completing plans and will soon call for bids for the erection of a new filtration plant at the municipal waterworks, to cost about \$250,000, with equipment. J. N. Chester, Union Bank Bldg., Pittsburgh, Pa., is engineer.

**BATAVIA**—The Gypsolite Co., Buffalo, a Delaware incorporation, has filed notice of organization to operate in this vicinity with a capital of \$1,000,000. Plans are nearing completion for the construction of a complete gypsum works on local site, comprising crushing, grinding and other departments, to cost about \$100,000, including equipment. J. F. H. Haggerty, 66 Bedford Ave., Buffalo, heads the company.

### North Carolina

**ELKIN**—The City Council has completed plans for the construction of a filtration plant in connection with a general waterworks system, and will commence work at an early date. Pegram & Reynolds, Winston-Salem, N. C., are engineers.

**MARSHALL**—The Town Council has plans under way for extensions in the municipal waterworks to cost about \$50,000, including chlorine sterilizer plant. T. A. Cox, 78 Patton Ave., Asheville, N. C., is engineer.

### Ohio

**YOUNGSTOWN**—The Paul J. Kalman Co., 22 West Monroe St., Chicago, Ill., manufacturer of steel bars, etc., will proceed at once with the construction of its new steel-fabricating plant on Cypress St., near Poland St., which has recently been held in temporary abeyance. The plant will cost about \$200,000, including equipment. A general contract for completion has been let to the Heller-Murray Co., Furnace St., Youngstown.

### Oklahoma

**MUSKOGEE**—The Oklahoma Producing & Refining Corp. has plans under way for the construction of a new storage and distributing plant to include oil stills, tanks and operating equipment estimated to cost about \$250,000 complete. The engineering department of the company is in charge.

**TULSA**—In connection with a new water development project at Mohawk, near Tulsa, the City Council will install an aerating and sterilizing plant, with complete filtration equipment. The work is estimated to cost in excess of \$5,000,000. J. D. Trammell, Fort Worth, Tex., and the Holway Engineering Co., Tulsa, are engineers.

### Oregon

**PORTLAND**—The Columbia Tire Co., 1401 Northwest Bank Bldg., will soon break ground for the construction of a new 2-story plant, to cost about \$100,000, with equipment. It will be used for the manufacture of automobile tires and other rubber goods. The Rasmussen Grace Co., 919 Chamber of Commerce Bldg., is engineer in charge. R. A. Wurzberg is head.

### Pennsylvania

**PHILADELPHIA**—H. Swoboda & Son, Inc., 1027 North Bodine St., has completed plans and will soon commence the erection of an addition to its leather-manufacturing plant, to be located at North Bodine and American Sts.

**PHILADELPHIA**—The Fibre Container Co., Fountain and Nixon Sts., is considering plans for the rebuilding of the portion of its plant, destroyed by fire April 27, with loss reported in excess of \$500,000, including equipment.

**WAYNESBORO**—The Frick Co. will soon call for bids for the construction of a new 1-story foundry, 300 x 600 ft., at its agricultural machinery works, estimated to cost approximately \$200,000, with equipment. A. J. Frick is in charge.

**CLAIRTON**—The Carnegie Steel Co., Pittsburgh, is completing plans and will commence foundation work immediately for the construction of an addition to its local by-product coke plant, estimated to cost close to \$20,000,000, including ovens and other equipment. It is planned to double the capacity of the present works.

**PITTSBURGH**—The Fleischmann Co., 701 Washington St., New York, N. Y., manufacturer of yeast, has tentative plans under consideration for the construction of a new local plant.



### Tennessee

**MEMPHIS**—The City Council plans to call for equipment bids during June for extensions and improvements in the municipal waterworks, including a new filtration plant, estimated to cost in excess of \$1,500,000. Fuller & McClintock, 421 Produce Exchange Bldg., Kansas City, Mo., are engineers.

### Texas

**FORT WORTH**—The Moco Monkey Grip Co., Oklahoma City, Okla., has acquired the local plant of the Texas Motor Car Association for a consideration of about \$295,000. The new owner will take immediate possession and plans for the installation of equipment for the manufacture of automobile tires. Employment will be given to about 850 men for initial operations.

### Virginia

**RICHMOND**—The Virginia Carolina Rubber Co., 10 North 19th St., has awarded a contract to E. L. Bass & Brother, 708 Bainbridge St., for the erection of a new 1-story plant, 100 x 125 ft., to cost about \$25,000.

### Washington

**FORT ANGELES**—The Union Oil Co. has commenced the erection of its proposed new storage and distributing plant on 2nd St., to have an initial capacity of about 100,000 gal. Three buildings will be constructed, 40 x 50 ft., 26 x 32 ft. and 12 x 15 ft., with steel tanks and other apparatus.

### West Virginia

**FAIRMONT**—The Dixie Co., recently organized, has perfected plans for the construction of a new plant on Speedway St., for oil storage and distribution, to include a complete chemical laboratory. A number of buildings will be erected, with steel tanks and operating equipment. The initial works will cost about \$30,000. Walter Smith is general manager.

### Wisconsin

**MILWAUKEE**—The Red Star Yeast & Produce Co., 79-83 Buffalo St., has awarded a contract to the Edward S. Steigerwald Co., 3012 Cherry St., for extensions and improvements in its yeast-manufacturing plant on 27th St. A. N. Graw is president.

### Canada

**MONTREAL, QUE.**—The John Cowan Chemical Co., Ltd., 179 Common St., is planning for the rebuilding of the portion of its plant destroyed by fire, April 26.

## New Companies

**THE FRASER CHEMICAL CO.**, Fraser (Macomb County), Mich., has been incorporated with a capital of \$25,000, to manufacture washing powders, paint emulsifiers and other chemical products. The incorporators are Ernest Lorenz and Simon Palmateer, Mount Clemens, Mich.; and Charles J. Reindel, Fraser.

**THE RILEY-FORD CO.**, Brooklyn, N. Y., has been incorporated with a capital of \$200,000, to manufacture industrial alcohol, chemicals and chemical byproducts. The incorporators are C. Riley, J. E. Ford and W. E. J. Collins. The company is represented by W. E. J. Collins & M. Kamber, 135 Broadway, New York.

**THE EAGLE REFINING CO.**, Houston, Tex., has been incorporated with a capital of \$10,000, to manufacture refined petroleum products. The incorporators are O. M. W. E. and Clarence Kendall, all of Dallas.

**THE SAVOIE RUBBER MFG. CO.**, 314 Pond St., Woonsocket, R. I., has been organized to manufacture rubber products. Phyllis J. Savoie heads the company.

**THE PIERPONT PAINT & COLOR CO.**, Camden, N. J., has been incorporated with a capital of \$50,000, to manufacture paints, varnishes, colors, etc. The incorporators are E. C. Young, M. A. Sudlow and W. J. Wix. The company is represented by the Corporation Co., 104 Market St., Camden.

**THE TIDEWATER CHEMICAL CO.**, New York, N. Y., has been incorporated with a capital of \$100,000, to manufacture chemicals, paints, dyestuffs, etc. The incorporators are F. H. Twyeffort, J. Moncrief and W. C. Dubois. The company is represented by Fletcher, Brown & Twyeffort, 342 Madison Ave., New York.

**THE ARMOR OIL CO.**, Room 846, 29 South La Salle St., Chicago, Ill., has been incorporated with a capital of \$10,000, to manufacture petroleum products. The incorporators are Morton H. Eddy, Oliver C. Heywood and Bernice Gormley.

**THE INDUSTRIAL PRODUCTS CORP.**, Trenton, N. J., has been incorporated with a capital of \$125,000, to manufacture brick, tile and kindred products. The incorporators are

John P. Fenner, William F. Garton and Fred P. Rearwin, 842 Greenwood Ave., Trenton.

**THE UNIVERSAL PRODUCERS CORP.**, Kansas City, Mo., has been incorporated under Delaware laws with capital of \$500,000, to manufacture petroleum products. The incorporators are C. W. Sheppard, Kansas City; F. J. Horton, Iola, Kan.; and L. L. Morgan, Chanute, Mo. The company is represented by the Colonial Charter Co., Ford Bldg., Wilmington, Del.

**THE D. C. CORP.**, 1317 Gratiot Ave., Detroit, Mich., has been chartered under state laws to manufacture soap products. The incorporators are Alexander Miller, Theodore M. Browne and Samuel Hoffenberg, 513 Kirby Ave., Detroit.

**THE WINNER LABORATORIES, INC.**, New York, N. Y., has been incorporated with a capital of \$50,000, to manufacture chemical products. The incorporators are A. A. and E. F. Smith, and J. Baptiste. The company is represented by Frost, Watson & Sharp, Albany, N. Y.

**THE CONVERSION PRODUCTS CORP.**, New York, N. Y., has been incorporated under Delaware laws with capital of \$100,000, to manufacture chemicals, dyes, etc. The incorporators are Lester C. Brulett, John J. Dole and George W. Study, New York. The company is represented by the United States Corporation Co., 65 Cedar St., New York.

**THE CHARLES S. WILBUR CO.**, Columbia, S. C., has been chartered under state laws to manufacture paints, varnishes, etc. The incorporators are Charles S. Wilbur, E. J. Duffy and George F. Von Kolnitz, all of Columbia.

**THE DUNIGAN-PATTON OIL CO.**, Tulsa, Okla., has been incorporated with a capital of \$100,000, to manufacture petroleum products. The incorporators are W. A. Dunigan, Tulsa; Paul Patton and C. D. West, Kansas City, Mo.

**THE FLORIDA FIBRE CONTAINERS, INC.**, Leesburg, Fla., has been incorporated with a capital of \$150,000, to manufacture fiber products. Edward E. Lacy is president; Gilbert D. Leach, vice-president; and Charles E. Daniel, secretary, all of Leesburg.

**THE CENTRAL RUBBER CO.**, 25 North Franklin St., Chicago, Ill., has been incorporated with a capital of \$15,000, to manufacture rubber goods. The incorporators are Robert M. Pierson, Francis J. Loughran and E. E. Schobel.

**THE ROY I. L. CARTER OIL CO.**, Wichita Falls, Tex., has been incorporated under Delaware laws, with a capital of \$1,000,000, to manufacture petroleum products. The incorporators are Roy I. L. Carter, Wichita Falls; I. W. Keys and Richard F. Bailey, Mexia, Tex. The company is represented by M. M. Harbordt, Dover, Del.

**THE LEON BLOCH BRASS CORP.**, New York, N. Y., has been incorporated with a capital of \$15,000, to manufacture brass and bronze products. The incorporators are L. H. and W. Bloch, and E. C. Cohen, 110 William St.

**THE FRANK M. KENNEDY PAINT & COLOR CO.**, Newark, N. J., has been incorporated with a capital of \$50,000, to manufacture paints, varnishes, colors, etc. The incorporators are M. C. and Frank H. Reynolds, and Frank M. Kennedy, 277 Passaic St., Newark.

**THE HARRINGTON PETROLEUM CORP.**, Cairo, Ill., has been incorporated under Delaware laws with a capital of \$1,000,000, to manufacture petroleum products. The incorporators are Herbert Harrington, V. C. Clarke and Casper K. Usener. The company is represented by the Delaware Registration Trust Co., 900 Market St., Wilmington.

**THE WAYNE BRICK CO.**, Wayne, W. Va., has been incorporated with a capital of \$50,000, to manufacture brick and other burned clay products. The incorporators are C. D. Martin, L. F. Adkins and W. F. Toney, all of Wayne.

**THE DUNN-GRENET OIL CO.**, Pittsburgh, Pa., has been incorporated with a capital of \$25,000, to manufacture oil products. V. P. Keefe, Sharpsburg, Pa., is treasurer.

**THE ACME POTTERY WORKS, INC.**, Trenton, N. J., has been incorporated with a capital of \$100,000, to manufacture pottery products. The incorporators are Noah W. Boch, A. H. Kennedy and M. K. Hoffman. The company is represented by Frederic R. Brace, 137 East State St., Trenton.

**THE PENNZOIL CO.**, Buffalo, N. Y., has been incorporated with a capital of \$1,000,000, to manufacture petroleum products. The incorporators are A. S. Matthews, D. Hyland and R. R. Bearsley. The company is represented by Kent, Cummings & Means, Dun Bldg., Buffalo.

**PHILLIP S. MALICKSON, INC.**, Philadelphia, Pa., has been incorporated with a capital

of \$100,000 under Delaware laws, to manufacture automobile tires and other rubber goods. The company is represented by the Corporation Guarantee & Trust Co., Land Title Bldg., Philadelphia.

**THE TULSA-TENNESSEE OIL CO.**, Salpaulpa, Tenn., has been incorporated with a capital of \$75,000, to manufacture petroleum products. The incorporators are George L. Burk, Tulsa; John M. Jones and Grason A. Bailey, Sweetwater, Tenn.

**THE BLACK SEAL CHEMICAL CO.**, Tampa, Fla., has been incorporated with a capital of \$10,000, to manufacture chemicals and chemical byproducts. H. C. McMichael is president; J. L. Moon, vice-president; and H. P. Boyce, secretary, all of Tampa.

**THE ATLAS PRODUCING CO.**, Kansas City, Mo., has been incorporated under Delaware laws, with a capital of \$2,500,000, to manufacture petroleum products. The incorporators are Joseph Clover, M. England and R. H. Yates, all of Kansas City. The company is represented by the Corporation Service Co., Wilmington, Del.

**FOOSHKILL & HIRSCH, INC.**, Woodhaven, L. I., has been incorporated with a capital of \$25,000, to manufacture ceramic products. The incorporators are W. and S. Hirsch and L. Fooskill. The company is represented by Slensby & Wolff, Richmond Hill, L. I.

**THE DENNETT & PRINCE LEATHER CO.**, Boston, Mass., has been incorporated with a capital of \$25,000, to manufacture leather products. The incorporators are Nathan W. Dennett, Auburndale, Mass.; Fred A. Prince, Sharon, Mass.; and Byron S. Kent, Melrose, Mass.

**THE TANNER OIL CO.**, Lake Charles, La., has been incorporated with a capital of \$100,000, to manufacture petroleum products. T. J. Tanner is president, and R. B. Sutherland, vice-president, both of Shreveport, La.; and W. C. Strange, Singer, La.

**THE H. A. BLOESER CO.**, Buffalo, N. Y., has been incorporated with a capital of \$5,000, to manufacture turpentine, industrial alcohol and chemical products. The incorporators are H. A. Bloeser, J. R. Hartley and G. E. Keller. The company is represented by Albert F. Geyer, Brisbane Bldg., Buffalo.

**THE AMERICAN TEXTILE SOAP CO.**, Springfield, Mass., has been incorporated with a capital of \$100,000, to manufacture soaps and affiliated products. The incorporators are Charles A. Stone, Robert F. Warren, both of Springfield; and Albert F. Alstrom, West Springfield, Mass.

**THE WEATHERFORD-BRAZOS REFINING CO.**, Weatherford, Tex., has been incorporated with a capital of \$200,000, to manufacture refined oil products. The incorporators are A. G. Fullerton, V. H. Williams and J. W. Wilson, all of Weatherford.

**THE RICHARDS CHEMICAL CO.**, Glen Olden, Pa., has been incorporated under Delaware laws with capital of \$50,000, to manufacture chemicals and chemical byproducts, drugs, etc. The incorporators are Arthur Richards, John H. Yates and J. Lamont Stewart, all of Glen Olden. The company is represented by the Corporation Guarantee & Trust Co., Land Title Bldg., Philadelphia, Pa.

**THE HOLSTON FOUNDRY CO.**, Knoxville, Tenn., has been incorporated with a capital of \$10,000, to manufacture iron, steel and other metal castings. The incorporators are H. G. Fowler, C. H. Johnson and C. E. Dawson, all of Knoxville.

**THE FRAMINGHAM MFG. CO.**, Framingham, Mass., has been incorporated with a capital of \$125,000, to manufacture iron and other metal castings. The incorporators are: Edward H. Talbot, Sharon, Mass., and Edward A. Hitz, Framingham.

**THE TRI-STATES OIL CO.**, New Boston, Tex., has been incorporated with a capital of \$150,000, to manufacture petroleum products. The incorporators are E. B. Guess, G. Roell and Walter Deemer, all of New Boston.

**THE ROSENWASSER LEATHER PRODUCTS CO.**, Brooklyn, N. Y., has been incorporated with a capital of \$10,000, to manufacture leather specialties. The incorporators are B. Merker, M. Jones and M. Kanin. The company is represented by C. E. Frankel, 19 West 44th St., New York.

**THE STAR OIL CO.**, Harrisville, W. Va., has been incorporated with a capital of \$50,000, to manufacture oil products. The incorporators are B. F. Patten, A. C. Woodford and Edward Robinson, all of Harrisville.

**THE CALIFORNIA-PACIFIC OIL CO.**, Wilmington, Del., has been incorporated under state laws with capital of \$5,000,000, to manufacture petroleum products. The company is represented by the Corporation Trust Co. of America, du Pont Bldg., Wilmington.

## Manufacturers' Catalogs

**PAUL MAEHLER CO.,** Chicago, Ill., has issued a new catalog which describes in detail its line of industrial ovens. The construction of Maehler ovens is given, as well as data on ventilation and circulation, assembling or setting up, fuels for industrial ovens, gas-heated ovens, electric heat and its adaptation to Maehler ovens, conveyor and special type ovens, core ovens, potash tanks and boiling cauldrons and oven accessory equipment. The booklet is well illustrated.

**THE PAGE STEEL & WIRE CO.,** Monessen, Pa., has just received a new handbook describing and illustrating interesting developments in the welding field.

**THE AEROIL BURNER CO., INC.,** Union Hill, N. J., has just received from the press its new bulletin, No. 20, on "Oil-Burning Appliances."

**CLEMENT K. QUINN & Co.,** Duluth, Minn., has issued its 1922 Analyses of Lake Superior Iron Ores.

**THE GRINDLE FUEL EQUIPMENT CO.,** Harvey, Ill., has issued its first general catalog on Grindle powdered fuel equipment, which contains 40 pages of text and illustrations. The advantages of powdered fuel in general is given and the advantages and operation of the Grindle system in particular. Copies will be sent to interested parties on request.

## Industrial Developments

**RUBBER**—The Mason Tire & Rubber Co., Akron, O., has increased its production schedule from 2,500 to 2,800 tires per day, and will soon advance this output to 3,500. The ultimate manufacture will be on a basis of 5,000 tires a day, and arrangements are being perfected for the installation of considerable new machinery for this purpose.

The Seiberling Tire & Rubber Co. is arranging for an immediate increase in production at its New Castle, Pa., and Harberton, O., plants, to a basis of 3,000 tires a day, as against a present schedule of slightly in excess of 2,000 tires.

The Kelly-Springfield Tire Co. is increasing production at its plant at Cumberland, Md.

The Firestone Tire & Rubber Co., Akron, O., is advancing production in its tube-manufacturing department, developing an output of about 3,400 tubes a day.

**PAPER**—The Parsons Pulp & Lumber Co., Horton, W. Va., has reopened its local pulp and paper mills, and will operate under a day and night shift until further notice.

Paper mills in the Montreal, Que., district are now operating on a basis of about 90 per cent of capacity.

The International Paper Co., New York, N. Y., has placed its new mill at Three Rivers, Que., on an increased operating basis for the manufacture of newsprint.

**CERAMIC**—The United States Refractories Corp. has resumed operations at its plant at Mount Union, Pa.

The Harbison-Walker Refractories Co., Pittsburgh, Pa., is advancing production at its plants at Mount Union, Pa., and is now operating at both the No. 1 and No. 2 factories.

The National Fireproofing Co., Pittsburgh, Pa., is increasing manufacture at its different plants to handle incoming orders. A number of large contracts have been obtained during the past month for hollow tile, vitrified clay conduit and other fireproofing specialties.

The General Refractories Co. has resumed operations at its plant at Mount Union, Pa., on a 6-day week basis.

**CEMENT**—The Giant Portland Cement Co. has resumed operations at its Central Mill, Egypt, Pa., following a shut-down since last summer. The company is running at capacity at its Reliance Mill.

Practically all mills in the Lehigh Valley cement district of Pennsylvania are now in operation, including reserve plant units. It is said that production within the next 2 or 3 weeks in this section will be the highest ever recorded.

The Copley Cement Co. is arranging for the immediate resumption of operations at its Mill B, Copley, Pa. The Mill C, of the company, with 10 kilns, is now running at capacity.

The Atlas Portland Cement Co., Northampton, Pa., is running full at its local mills, and has announced an increase in wages, effective May 1. The Lawrence Portland Cement Co., in this same section,

has also increased the wage scale at its plant.

The International Cement Co., New York, N. Y., has increased production at its different mills, and is now making heavy shipments from the plants.

**IRON AND STEEL**—The Charcoal Iron Co., Manistique, Mich., is arranging for the resumption of operations at its plants at Boyne City and Newberry, Mich., not later than May 15.

The Brier Hill Steel Co., Youngstown, O., has blown in another blast furnace at its mills. The company is also planning for the early resumption of an additional sheet mill, now said to be impossible through labor shortage.

The Trumbull Steel Co., Warren, O., is now operating 34 hot mills at its plant. The Liberty Steel Co., in the same district, is running 10 hot mills at its works.

The Wheeling Steel Corp. has resumed operations at three mills, located at Yorkville, O.; Creek and Beech Bottom, W. Va., respectively. This brings production up to the highest point for the company within the past 18 months.

The Bethlehem Steel Co. has reopened another finishing mill at its Lebanon, Pa., works, giving employment to about 100 additional men. The unit has been idle for more than a year past.

The American Steel Foundries, Chicago, Ill., is arranging for an immediate increase of 15 per cent in production at its various plants. The company is now running at more than 50 per cent in advance of the output at this time a year ago.

The Rogers-Brown Iron Co., Buffalo, N. Y., has increased production to a capacity basis at its blast furnaces. The company is said to have orders on hand to insure this schedule for the remainder of the year.

The Worth Brothers Steel Co., Marcus Hook, Pa., is increasing production at its mills and adding to the working force. It is planned to adopt a double operating shift at an early date.

The Gulf States Steel Co., Birmingham, Ala., is running full at all of its finishing mills. Two open-hearth furnaces are in service.

The Steel & Tube Co. of America, Chicago, Ill., is running 7 of its 8 blast furnaces at capacity, with orders on hand to insure this basis of output for the remainder of 1922.

## Capital Increases, Etc.

**THE NEW YORK RUBBER CO.,** 84 Reade St., New York, N. Y., has filed notice of increase in capital from \$500,000 to \$800,000.

**THE PEERLESS OIL CORP.,** Richmond, Va., has filed notice of increase in capital from \$250,000 to \$500,000. A. L. Hawse is secretary.

**THE GRAND CORRUGATED PAPER CO., INC.,** 30 Crosby St., New York, N. Y., has filed notice of increase in capital from \$150,000 to \$300,000.

**THE UNION BAG & PAPER CORP.,** Woolworth Bldg., New York, N. Y., manufacturer of paper products, with plant at Hudson Falls, N. Y., has disposed of a bond issue of \$6,500,000, the proceeds to be used for general operations, financing, etc.

**THE WESTON GLASS CO.,** Weston, W. Va., has filed notice of increase in capital from \$50,000 to \$75,000.

**THE FORT ORANGE PAPER CO.,** Castleton, N. Y., has filed notice of increase in capital from \$200,000 to \$500,000.

**THE H. C. FRY GLASS CO.,** Rochester, Pa., is disposing of a bond issue of \$600,000, the proceeds to be used for additional working capital, expansion, etc.

**THE DECATUR UNION CHEMICAL CO.,** Decatur, Ill., has filed notice of increase in capital from \$150,000 to \$180,000.

**THE BULLION CHEMICAL CO.,** Memphis, Tenn., has filed notice of increase in capital from \$50,000 to \$150,000.

**THE PRODUCERS & REFINERS CORP.,** California Bldg., Denver, Col., operating oil refineries at West Tulsa and Blackwell, Okla., has disposed of a bond issue of \$2,000,000, the proceeds to be used for general operations, expansion, etc. F. E. Kistler is chairman of the board.

**THE ROGERS-BROWN IRON CO.,** Buffalo, N. Y., producer of pig iron, coke, ferro-manganese, fluorspar, etc., has disposed of a bond issue of \$4,000,000, the proceeds to be used for general operations, financing, etc. William A. Rogers is president.

**THE CHAPEL LEATHER CO.,** 303 Prudential Bldg., Newark, N. J., has filed notice of dissolution under state laws.

**THE NEW YORK BRASS FOUNDRY CO.,** 405 Broome St., New York, N. Y., has filed notice of increase in capital from \$10,000 to \$50,000.

## Coming Meetings and Events

**AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE** will hold a joint meeting with the Pacific Division of the association, on the occasion of the annual meeting of the latter, in Salt Lake City June 22 to 24.

**AMERICAN ASSOCIATION OF ENGINEERS** will hold its eighth annual convention at Salt Lake City, Utah, June 4-6.

**AMERICAN CHEMICAL SOCIETY** will hold its fall meeting in Pittsburgh, Pa., Sept. 5 to 9.

**AMERICAN ELECTROCHEMICAL SOCIETY** will hold its fall meeting in Montreal, Sept. 21, 22 and 23. Headquarters will be at the Windsor Hotel.

**AMERICAN FOUNDRYMEN'S ASSOCIATION** will hold its next convention and exhibit at Rochester, N. Y., during the week of June 9, 1922. Meeting will be held in the spring instead of in the fall as heretofore.

**AMERICAN INSTITUTE OF CHEMICAL ENGINEERS** will hold its summer meeting at Niagara Falls, Canada, June 19 to 22. Headquarters will be at the Clifton Hotel.

**AMERICAN LEATHER CHEMISTS ASSOCIATION** will hold its nineteenth annual meeting at Bigwin Inn, Bigwin Island, in the Lake of Bays district, Ontario, Canada, on June 21, 22 and 23.

**AMERICAN OIL CHEMISTS' SOCIETY** will hold its annual meeting at the Grunewald Hotel, New Orleans, La., June 5 and 6.

**AMERICAN PULP AND PAPER MILL SUPERINTENDENTS ASSOCIATION** will meet in Kalamazoo, Mich., June 1, 2 and 3.

**AMERICAN SOCIETY OF MECHANICAL ENGINEERS** is holding its spring meeting at Atlanta, Ga., May 8-11.

**AMERICAN SOCIETY FOR STEEL TREATING** will hold a sectional meeting at the Bureau of Mines auditorium, Pittsburgh, Pa., on May 25 and 26. The International Steel Exposition and Convention of the society will be held in the General Motors Bldg., Detroit, Mich., Oct. 2 to 7.

**AMERICAN SOCIETY FOR TESTING MATERIALS** will hold its twenty-fifth annual meeting June 26 to July 1, at Atlantic City, N. J. Headquarters will be at the Chalfonte-Haddon Hall Hotel.

**ANNUAL SAFETY CONGRESS** of the NATIONAL SAFETY COUNCIL will be held in Detroit, Mich., Aug. 28-Sept. 2.

**CANADIAN INSTITUTE OF CHEMISTRY** and the SOCIETY OF CHEMICAL INDUSTRY will hold their annual meetings in Ottawa May 15-17.

**CERAMIC SOCIETY (London)** is to have a foreign trip to Sweden and Denmark from May 27 to June 10.

**CHAMBER OF COMMERCE OF THE UNITED STATES** will hold its tenth annual meeting in Washington, D. C., May 15 to 18.

**INTERNATIONAL UNION OF PURE AND APPLIED CHEMISTRY** will hold a meeting at Lyons, France, June 27 to 30.

**NATIONAL ASSOCIATION OF PURCHASING AGENTS EXPOSITION** (the "Informashov") will be held in connection with the seventh annual convention of the association at Exposition Park, Rochester, N. Y., May 15-22.

**NATIONAL COAL ASSOCIATION** will hold its annual meeting at Congress Hall, Chicago, May 24-25.

**NATIONAL EXPOSITION OF CHEMICAL INDUSTRIES (EIGHTH)** will be held in New York Sept. 11-16.

**NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING** will be held at the Grand Central Palace Dec. 7-13, with the exception of the intervening Sunday.

**NATIONAL FERTILIZER ASSOCIATION** will hold its twenty-ninth annual convention at the Greenbrier, White Sulphur Springs, W. Va., the week of June 12.

**NINTH NATIONAL FOREIGN TRADE CONVENTION** will be held at Philadelphia May 10 to 12.

**NEW JERSEY CHEMICAL SOCIETY** will meet at Stettens Restaurant, 842 Broad St., Newark, N. J., the second Monday of every month.

**STAMFORD CHEMICAL SOCIETY, Stamford, Conn.,** holds a meeting in the lecture room of the local high school on the fourth Monday of each month, except June, July, August and September.

The following meetings are scheduled to be held in Rumford Hall, the Chemists' Club, New York: May 12—Société de Chimie Industrielle (in charge), American Chemical Society, Society of Chemical Industry, American Electrochemical Society, joint meeting; May 19—Society of Chemical Industry, regular meeting; June 9—American Chemical Society, regular meeting.